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Bacteriology.

WILLIAM C. DOBSON, M. D.

> BIOLOGY, chemistry, medicine and surgery, in the progress of their evolution, have contributed little by little to the growth of a new branch of learning whose subsequent development has been of inestimable importance to each. Indeed, bacteriology illustrates the old adage, "The child is father of the man," for while it is the offspring of the medicine of the past, it has established itself as the dictator of the medicine of the present and future, especially in the management of the infectious diseases.—*McFarland.*

In presenting this subject to our readers, we open with a brief history of bacteriology, as outlined by Joseph McFarland in his admirable work on Pathogenic Bacteria, published by W. B. Saunders of Philadelphia.

Our aim is not only to interest physicians, but also to stimulate microscopists to greater effort and research along these lines. Bacteriology is not only a highly important branch of medicine, but also a subject of especial interest to the microscopist. Without the aid of the microscope, little, if anything would to-day be known of pathogenic organisms, in which case the study of infectious diseases would be materially impeded, and that progress so essential to medicine and surgery, hopelessly retarded.

THE DOCTRINE OF SPONTANEOUS GENERATION.

"Among the early Greeks we find that Anaximander (43d Olympiad, 610 B. C.) of Miletus held the theory that animals were formed from moisture. Empedocles of Agrigentum (450 B. C.) attributed to spontaneous generation all the living beings which he found peopling the earth.

Aristotle (B. C. 384) is not so general in his view of the subject, but asserts that "*sometimes* animals are formed in putrefying soil, sometimes in plants, and sometimes in the fluids of other animals." Three centuries later, in his disquisition upon the Pythagorean philosophy, we find Ovid defending the same doctrine, while in the Georgics Virgil gives directions for the production of bees. Not only was the doctrine of spontaneous generation of life, current among the ancients, but we find it persisting through the Middle Ages, and descending to our own generation to be an accidental but important factor in the development of a new branch of science. In 1542, in his treatise called *De Subtilitate*, we find Cardan asserting that water engenders fishes, and that many animals spring from fermentation. Van Helmont gives special instructions for the artificial production of mice, and Kircher in his *Mundus Subterraneous* (chapter "De Panspermia Rerum") describes and *actually figures* certain animals which were produced under his own eyes by the transforming influence of water on fragments of stems from different plants. About 1686, Francesco Redi seems to have been the first to doubt that the maggots familiar in putrid meat arose *de novo*. "Watching meat in its passage from freshness to decay, prior to the appearance of maggots, he invariably observed flies buzzing around the meat and frequently alighting on it. The maggots, he said, might be the half-developed progeny of these flies.

Placing fresh meat in a jar covered with paper, he found that although the meat putrefied in the ordinary way, it never bred maggots, while meat in open jars soon swarmed with these organisms. For paper he substituted fine wire gauze, through which the odor of meat could arise.

Over it the flies buzzed, and on it they laid their eggs, but the meshes being too small to permit the eggs to fall through, no maggots generated in the meat; they were on the contrary hatched on the gauze.

By a series of such experiments Redi destroyed the belief in the spontaneous generation of maggots in meat, and with it many related beliefs."

In 1683, Anthony van Leeuwenhoek, justly called the "Father of microscopy," demonstrated the continuity of arteries and veins through intervening capillaries, thus affording ocular proof of Harvey's discovery of the circulation of the blood; discovered bacteria, seeing them first in saliva, discovered the rotifers, and first saw the little globules in yeast which Latour and Schwann subsequently proved to be plants.

Leeuwenhoek involuntarily reopened the old controversy about spontaneous generation, by bringing forward a new world, peopled by creatures of such minuteness as to suggest not only a close relationship to the ultimate molecules of matter, but an easy transition from them. In succeeding years the development of the compound microscope showed these minute organisms to exist in such numbers that putrescent infusions, both animal and vegetable, literally teemed with them, one drop of such a liquid furnishing a banquet for millions. Abbe Lazzaro Spallanzani (1777) filled flasks with organic infusions, sealed their necks, and, after subjecting their contents to the temperature of boiling water, placed them under conditions favorable for the development of life, without however, being able to produce it. Spallanzani's critics, however, objected to his experiment on the ground that air is essential to life, and that in his flasks the air was excluded by the hermetically-sealed necks. Schulze (1836) set the objection aside by filling a flask only half full of distilled water, to which animal and vegetable matters were added, boiling the contents to destroy the vitality of any organisms which might already exist in them,then sucking daily into the flask a certain amount of air which had passed through a series of bulbs containing concentrated sulphuric acid, in which it was supposed that whatever germs of life the air might contain would be destroyed. This flask was kept from May to August; air was passed through it daily, yet without the development of any infusorial life. It must have been a remarkably germ-free atmosphere in which Schultze worked, for, as was shown by those who repeated his experiment, under the conditions that he regarded as certainly excluding all life, germs can readily enter with the air. The term "infusorial life" having been used here, it is well to observe that during all the early part of their recognized existence the bacteria were regarded as animal organisms and classed among the infusoria. Tyndall, stimulated by the work of Pasteur, conclusively proved that the micro-organismal germs were in the dust suspended in the atmosphere, not ubiquitous in their distribution.

His experiments were very ingenious and are of much interest. First preparing light wooden chambers, with one large glass window in the front and one smaller window in each side, he arranged a series of test-tubes in the bottom, half in and half out of the chamber, and a pipette in the top, working through a rubber diaphragm, so that when desired,the tubes, one by one could be filled through it. The chamber was first allowed to stand until all the contained dust had settled, and was then submitted to an optical test to determine the purity of its atmosphere, a powerful ray of light being passed through the side windows. When viewed through the front window, this ray was visible as long as there were particles suspended in the atmosphere to reflect it. When the dust had completely settled and the light ray was invisible because of the purity of the atmosphere, the tubes were cautiously filled with urine, beef broth, and a variety of animal and vegetable broths, great care being taken that in the manipulation the pipette should not disturb the dust. Their contents were then boiled by submergence in a pan of hot brine placed beneath the chamber, in contact with the projecting ends of the tubes, and allowed to remain undisturbed for days, weeks or months. In nearly every case life failed to develope after the purity of the atmosphere was established.

The following extracts from Tyndall's work will illustrate how slowly the doctrine of spontaneous generation was abandoned: "At a meeting of the Pathological Society of London, held April 6, 1875, the 'germ theory' of disease was formally introduced as a subject for discussion, the debate being continued with great ability and earnestness at subsequent meetings.

The conference was attended by many distinguished medical men, some of whom were profoundly influenced by the arguments, and none of whom disputed the facts brought forward against the theory on that occasion." "The leader of the debate, and the most prominent speaker, was Dr. Bastian, to whom also fell the task of replying on all the questions raised." "The coexistence of bacteria and contageous disease was admitted; but, instead of considering these organisms as probably the essence, or an inseparable part of the essence, of the contagium, Dr. Bastian contended that *they were pathological products spontaneously generated in the body after it had been rendered diseased by the real contagium.*"

"The grouping of the ultimate particles of matter to form living organisms Dr. Bastian considered to be an operation as little requiring the action of antecedent life as their grouping to form any of the less complex chemical compounds." "Such opposition, must of course, stand or fall by the evidence which its supporter is able to produce, and accordingly Dr. Bastian appeals to the law and testimony of experiment as demonstrating the soundness of his view." "He seems quite aware of the gravity of the matter at hand; this is his deliberate and almost solemn appeal: "With the view of settling these questions, therefore, we may carefully prepare an infusion from some animal tissue, be it muscle, kidney or liver; we may place it in a flask whose neck is drawn out and narrowed in the blowpipe flame; we may boil the fluid, seal the vessel during ebullition, and, keeping it in a warm place, may await the result, as I have often done. ...... After a variable time the previously heated fluid within the hermetically-sealed flask swarms more or less plentifully with bacteria and the allied organisms, even though the fluids have been much degraded in quality by exposure to the temperature of 212° F., and have in all probability been rendered far less prone to engender independent living units than the unheated fluids in the tissue would be. These somewhat lengthy quotations are of great interest, for they show exactly the state of the scientific mind at a period as recent as twenty-five years ago.

FERMENTATION AND PUTREFACTION.

As in the biologic world the generation of life was an all-absorbing problem, so in the world of chemistry the phenomena of fermentation and putrefaction were inexplicable so long as the nature of the ferments was not understood. Cagniard Latour and Schwann in the year 1837 succeeded in proving that the minute oval bodies which had been observed in yeast since the time of Leeuwenhoek were living organisms—vegetable forms—capable of growth.

While yeast was looked upon as an inert substance in the act of fermenting, it was impossible to understand how it could impart fermentation to other substances ; but when it was learned by Latour that the essential element of yeast was a growing plant, the phenomenon became a perfectly natural consequence of life.

Not only the alcoholic, but also the acetic, lactic and butyric fermentations have been shown to result from the energy of low forms of vegetable life, chiefly bacterial in nature. Prejudice, however, prevented many chemists from accepting this view of the subject and Liebig strenuously adhered to his theory that fermentation was the result of internal molecular movement which a body in the course of decomposition communicates to other matter in which the elements are connected by a very feeble affinity. Pasteur was the first to declare and prove that fermentation is an ordinary chemic transformation of certain substances, taking place as the result of the action of living cells, and that the capacity to produce it resides in all animal and vegetable cells, though in varying degree. In 1862, he published a paper "On the Organized Corpuscles existing in the Atmosphere," in which he showed that many of the floating particles which he had been able to collect from the atmosphere of his laboratory were organized bodies. If these were planted in sterile infusions, abundant crops of micro-organisms were obtainable. By the use of more refined methods he repeated the experiments of others, and showed clearly that "the cause which communicated life to his infusions came from the air, but was not evenly distributed through it." Three years later he showed that the organized corpuscles which he had found in the air were the spores or seeds of minute plants, and that many of them possessed the property of withstanding the temperature of boiling water—a property which explained the peculiar results of many previous experimenters, who failed to prevent the development of life in boiled liquids enclosed in hermetically-sealed flasks. Chevreul and Pasteur (about 1836) proved that animal solids did not putrefy or decompose if kept free from the access of germs, and thus suggested to surgeons that the putrefaction which occurred in wounds was due rather to the entrance of something from without, than to some change within.

The deadly nature of the discharges from these wounds had been shown in a rough manner by Gaspard as early as 1822, by injecting some of the material into the veins of animals.

THE STUDY OF THE INFECTIOUS DISEASES.

Probably the first writing in which the direct relationship between micro-organisms and disease is indicated is that by Varro, which says: "It is also to be noticed, if there be any marshy places, that certain minute animals breed there which are invisible to the eye, and yet, getting into the system through mouth and nostrils, come serious disorders (diseases which are difficult to treat)"—a doctrine which, as Prof. Lamberton, to whom I am indebted for the extract, points out, is handed down to us from "the days of Cicero and Cæsar," yet corresponds closely to the ideas of malaria which we entertain at present.

Surgical methods of treatment depending for their success upon exclusion of the air, and of course, incidentally if unknowingly, exclusion of bacteria, seem to have been practiced quite early. Theodoric of Bologne about 1260 taught that the action of the air upon wounds induced a pathologic condition predisposing to suppuration. He also treated wounds with hot wine fomentations. The wine was feebly antiseptic, kept the surface free from bacteria, and the treatment was, in consequence, a modification of what in later centuries formed antiseptic surgery.

Henri de Mondeville in 1306 went even further than Theodoric, whom he followed, and taught the necessity of bringing the edges of a wound together, covered it with an exclusive plaster compounded of turpentine, resin and wax, and then applied the hot wine fomentation. In 1671 Kircher wrote a book in which he expressed the opinion that puerperal purpura, measles and various other fevers were the result of a putrefaction caused by worms or animalculæ. His opinions were thought by his contemporaries to be founded upon too little evidence, and were not received.

Plencig of Vienna became convinced that there was an undoubted connection between microscopic animalcules exhibited by the microscope and the origin of disease, and advanced this opinion as early as 1782.

Unfortunately, the opinions of Plencig seem not to have been accepted by others, and were soon forgotten. In 1704 John Colboch described "a new and secret method of treating wounds by which healing took place quickly, without inflammation or suppuration." Boehm succeeded in 1838 in demonstrating the occurrence of yeast plants in the stools of cholera, and conjectured that the process of fermentation was concerned in the causation of that disease.

In 1840, Henle determined that the cause of infectious diseases was to be sought for in minute living organisms or fungi. He may be looked upon as the real propounder of the *Germ Theory of Disease,* for he not only collected facts and expressed opinions, but also investigated the subject ably. The requirements which he formulated in order that the theory might be proved were so severe that he was never able to attain to them with the crude methods at his disposal. They were so ably elaborated, however, that in after years they were again postulated by Koch, and it is only by strict conformity with them that the definite relationship between bacteria and disease has been determined. Briefly summarized the requirements are as follows :

1. A specific micro-organism must be constantly associated with the disease.

2. It must be isolated and studied apart from the disease.

3. When introduced into healthy animals it must produce the disease.

Pollender (1849) and Davaine (1850) succeeded in demonstrating the presence of the anthrax bacillus in the blood of animals suffering from and dead of that disease. Several years later (1863), Davaine, having made numerous inoculation-experiments, demonstrated that this bacillus was the *materies morbi* of the disease. The bacillus of anthrax was probably the first bacterium shown to be specific for a disease. Being a very large bacillus and a strong vegetative organism, its growth was easily observed, while the disease was one readily communicated to animals for experimental purposes. In 1873 Obermeier observed that actively motile flexible spiral organisms were present in large numbers in the blood of patients in the febrile stages of relapsing fever. Klebs who was one of the pioneers of the germ theory, published in 1872, his work upon septicemia and pyemia, in which he expressed himself convinced that the causes of these diseases must come from without the body, Billroth strongly opposed such an idea, asserting that fungi had no especial importance either in the processes of disease or in those of decomposition, but that, existing everywhere in the air, they rapidly developed in the body as soon as through putrefaction a "Faulnisszymoid," or through inflammation a "phlogistischezymoid," supplying the necessary feeding grounds, was produced. In 1875 the number of scientific men who had entirely abandoned the doctrine of spontaneous generation and embraced the germ theory of disease was small and most of those who accepted it were experimenters. A great majority of medical men either believed, like Billroth, that the presence of fungi where decomposition was in progress was an accidental result of their universal distribution, or, being still more conservative, retained the old unquestioning faith that the bacteria, whose presence in putrescent wounds as well as in the artificially prepared media was unquestionable, were spontaneously generated there. Before many of the important bacteria had been discovered, and while ideas upon the relation of micro-organisms to disease were most crude, there were suggested some practical applications that produced greater agitation and incited more observation and experimentation than anything suggested in surgery since the introduction of anaesthetics—namely, *antisepsis.* "It is to one of old Scotia's sons, Sir Joseph Lister, that the everlasting gratitude of the world is due for the knowledge we possess in regard to the relation existing between micro-organisms and inflammation and suppuration, and the power to render wounds aseptic through the action of germicidal substances." Lister, convinced that inflammation and suppuration were due to the entrance of germs from the air, instruments, fingers, etc., into wounds, suggested the employment of carbolic acid for the purpose of keeping sterile the hands of the operator, the skin of the patient, the surface of the wound, and the instruments used. He finally concluded an operation by a protective dressing to exclude the entrance of of germs at a subsequent period. Listerism originated in 1875, and when Koch published his famous work on the Wundinfectionskrankheiten, (or traumatici nfectious diseases), in 1878, it spread slowly at first, but surely in the end, to all departments of surgery and obstetrics.

From time to time, as the need for them was realized, the genius of the investigators provided devices which materially aided them in this work. Some of these have been indispensible throughout all subsequent investigations and have made possible many discoveries that must otherwise have failed. Among them may be mentioned the improvement of the compound microscope, the use of sterilized culture-fluids by Pasteur, the introduction of solid culture-media and the isolation methods by Koch, the use of the cotton plug by Schroeder and van Dusch, and the introduction of the anilin dyes by Weigert. It is interesting to note that after the discovery of the anthrax bacillus by Pollender and Davaine in 1849 there was a prolonged period during which no important pathogenic organisms were discovered, but during which the technic was being elaborated. This was again followed by a period during which important additions followed each other in rapid succession.

Thus, in 1873, Obermeier discovered the Spirillum Obermeiri of relapsing fever.

In 1879, Hansen announced the discovery of bacilli in the cells of leprous nodules. The same year Neisser discovered the gonococcus to be specific for gonorrhoea.

In 1880, the bacillus of typhoid fever was first observed by Eberth, and independently by Koch.

In 1880, Pasteur published his work upon "Chicken-cholera." In the same year Sternberg described the pneumococcus, calling it the *Micrococcus Pasteur*.

In 1882, Koch made himself immortal by his discovery of and work upon the tubercle bacillus. The same year Pasteur published a work upon *Rouget du Porc,* and Lofler and Schultz reported the discovery of the bacillus of glanders.

In 1884, Koch reported the discovery of the "comma bacillus," the cause of cholera, and in the same year Lœffler discovered the diphtheria bacillus, and Nicolaier the tetanus bacillus.

In 1892, Canon and Pfeiffer discovered the bacillus of influenza.

In 1894, Yersin and Kitasato independently isolated the bacillus causing the bubonic plague then prevalent in Hong-Kong.

In 1894, Sanarelli discovered the bacillus icteroides, thought to be specific for yellow fever.

A new era in bacteriology, and probably the most triumphant result of the modern scientific study of disease, was inaugurated by Behring, who presented to the world the "Blood-serum therapy," and showed as the result of prolonged, elaborate and profound study of the subject of immunity, that in the blood of animals with acquired immunity to certain diseases (diphtheria and tetanus) a substance was held in solution which was potent to save the lives of other animals suffering from the same diseases."

Notes on Microscopy.

F. SHILLINGTON SCALES, F. R. M. S.

Glass Cells for Microscope Slides.—There several methods for making glass cells for slides of insects, samples of ore, etc., each more or less convenient, according to the depth of the proposed cell. For cells from one-tenth inch in depth and upward, we have found the plan of cutting a ring off a bit of soft glass tubing, the easiest and best. This is done very quickly and surely by running a diamond pencil around the tubing at the required distance from the end, and touching the line thus made with the point of a red-hot poker or iron rod. To run the line smoothly and evenly, make a little supporter for the tube by nailing a couple of upright strips, notched at the top in V shape, to a wooden block, six inches long. Let the tube rest in the notches, apply the diamond firmly to the glass, and revolve the tube slowly, away from the person. A little practice will enable one to make a clean-cut scratch entirely around the tubing. In the absence of the diamond, a little slitting file may be used.

After the ring is removed, smooth the edges by grinding with emery powder on a leaden plate. For shallow cells, an ordinary cover-glass may be used, by cementing it to a metallic ring of proper size, and when firmly fixed, punch a hole through the center. Smooth the edge of the hole with a round file. Small irregularities will not be visible when the cell is filled with mounting medium. Another plan is to wet the cover-glass with a little saliva, and press it down on the center of the turn-table. Set the plate to revolving, and touch the surface of the glass with a writing diamond. With a little practice, this is by far the neatest and most expeditious way.—*National Druggist.*

Number of Species of Plants.—Professor S. H. Vines, in his opening address to the Botanical Section of the British Association at Bradford, gave some interesting figures as to the number of species of plants at present known. The figures may be tabulated as follows:

SPECIES OF PLANTS.

Phanerogams	Dicotyledons	78,200	
	Monocotyledons	19,600	
	Gymnosperms	2,420	
		100,220	
	Subsequent additions	5,011	
			105,231
Pteridophyta	Filicinæ (including Isoetes) about.	3,000	
	Lycopodinæ, about	432	
	Eqisitinæ about	20	
			3,452
Bryophyta	Musci	4,609	
	Hepaticæ	3,041	
			7,650
Thallophyta	Fungi, (including Bacteria)	39,663	
	Lichens	5,600	
	Algæ (including 6000 Diatoms)	14,000	
			59,263

Making a grand total of......................175,596 which, when compared with the 10,000 species of plants known to Linnaeus in the latter half of the last century, show how vast have been our additions to the knowledge of plants. The amount of work for microscopists especially in the latter sections, appears to be unlimited.

PRESERVATION OF MEDUSÆ.—Medusæ should be killed by adding a few drops of concentrated chromic acid to sea-water containing them. Then well wash in sea-water until the chromic acid has disappeared.

Gradually add glycerin and alcohol to water, until objects are in pure glycerin and alcohol of same specific gravity as sea-water.

FRESHWATER ENTOMOSTRACHA.—Mr. D. J. Scourfield, in the Proceedings of the South London Entomological and Natural History Society, calls attention to the value of Entomostracha in experimental biology. "Their commonness in all parts of the country, their transparency, the ease with which they can be isolated and reared under all sorts of conditions, mark out the Entomostracha as particularly well fitted for observation in connection with even the most fundamental biological problems of the day." He adds: "We badly want detailed studies on local faunas, on the seasonal distribution and variation of different species, on the faunas of various types of ponds, on the food of the most abundant forms, and many similar subjects."

CAUSES OF FRACTURE OF STEEL RAILS.—The value of the microscopical examination of steel will be brought prominently before the general public by the recently issued report of the Board of Trade committee appointed to examine into the cause of fracture of a steel rail at St. Neot's station on Dec. 10, 1895, by which a serious accident happened to the down Scotch express. The report itself, dealing as it does with various experimental work undertaken by well-known experts, is somewhat inconclusive, but the microscopic examination by Sir William Roberts-Austen gave results of the utmost interest and value. Briefly stated, it may be said that, according to this eminent authority, good rail steel consists of "ferrite," or iron free from carbon, and "pearlite," which is a mixture of alternate bands of ferrite and "cementite," the carbide corresponding to the formula Fe_3C.

The well developed pearlite with a conspicious banded structure is readily shown microscopically, and is characteristic of good rail steel. When, however, steel is hardened by "quenching," pearlite is absent, and "martensite," which consists of interlacing crystalline fibres without banded structure, takes its place. Sir William Roberts-Austen says that "the presence of martensite in a rail should at once cause it to be viewed with extreme suspicion, as showing that the rail is too hard locally to be safe in use." The broken rail at St. Neot's showed an outside layer of martensite one hundredth of an inch thick. The report deals further with minute cracks found in this and other rails, and the enormous increase in liability to fracture occasioned thereby, and one conclusion drawn is that patches of martensite can be produced in a rail, when in use, by local treating caused by skidding, followed by the rapid extraction of heat by the cold rail. It is thus evident that the microscope will prove to be an increasingly valuable means of studying the complex structure of steel. For this purpose and for the examination of alloys it is used, and already a quite voluminous literature is growing up around the subject.

The Compound Microscope in Pharmacy.

ALBERT SCHNEIDER, M. D., Ph., D.

Compound Microscopes with objectives and oculars fairly well corrected for spherical and chromatic aberration, have been in use for nearly seventy-years, but it is only recently that they have been extensively employed in pharmaceutical practice. This is due to the fact that pharmacy as a science is of recent origin ; only within the last decade have the courses of instruction in the colleges of pharmacy been based upon scientific principles—at least this applies to the department of botany and its various branches, as vegetable materia-medica, vegetable pharmacography and powdered vegetable drugs. The leaders in pharmaceutical education admit that a good compound microscope is a part of the necessary equipment of the intelligent, competent, practicing pharmacist. It is, therefore, much to be regretted that there are a number of so-called colleges of pharmacy from which students are graduated, who have never used or even seen a compound microscope.

Such graduates are wholly unfit for the duties of a modern pharmacist, because it is only through the intelligent use of this instrument that he is enabled to vouch for the purity of most of the vegetable drugs and many other substances used in his practice. The advanced workers in Pharmaceutical Vegetable Histology abroad, as well as in this country, have employed the microscope for a number of years. A few eminent specialists of Germany and France have studied the histology of medicinal plants since 1825. The earlier German investigators also devoted much of their attention to the microscopical examination of foods and spices, textile fabrics and various other commercial products. Some of this work was really herculean, and it would be highly interesting to enter into a fuller discussion, but space will not permit. According to Pocklington, the use of the compound microscope in English pharmacy, dates from 1850, when Dr. Hassell laid before the Botanical Society of London, a paper on the histology of coffee and its adulterants. The microscope was introduced into American pharmacy a few years later. In England, as well as in the United States, the use of the compound microscope in pharmaceutical practice progressed very slowly, until about 1880 or a few years later, in spite of the earnest recommendation of a few leading teachers and investigators. Since 1880, some very energetic work has been done in America. Many of the investigations are, however, defective, and a mere repetition of the work already done in Continental Europe, particularly in Germany.

It is much to be regretted that the truly scientific spirit does not permeate the English-speaking nations. The great majority of the scientific work done is primarily instigated and abetted by commercialism and hence does not attain to the lasting, far reaching results of the work of our patient and careful German investigators whose prime motive is to find out. In 1853, Dr. F. Hoffmann recommended the use of the compound microscope in American pharmacy, calling attention to the value of this instrument in the examination of vegetable drugs and their adulterants.

It was, however, not until some thirty years later that the compound microscope was used to any considerable extent in the study of vegetable drugs. It was looked upon as an impracticable instrument, having no commercial significance, and presenting no advantages over the simple microscope. Now and then some teacher or investigator would arise and reiterate the recommendations of Dr. Hoffman, or present some new phase of microscopic work in pharmacy, only to be met with the same indifference, if not actual opposition and ridicule. It is, therefore, little wonder that slow progress should have been made in the histologic study of medicinal plants. In Germany the compound microscope found a steady use in pharmaceutical practice. In 1865, Berg published his excellent atlas illustrating the histology of the more important vegetable drugs, and even at this date there is nothing produced by an English or American investigator which equals this work.—*Meyer Brothers Druggist.*

Formaldehyde.—It is put into milk for a preservative. Five tests for its detection are reported by Herman Harms in the Bulletin of Pharmacy, Detroit, Mich. Send 10 cents for the August number of 1900.

Extracts From English Postal Microscopical Society Note Books.

WILLIAM H. BURBIDGE.

Polyp of Alcyonium palmatum. One of the Anthozoa, is of a higher organization than Hydroida. It is the cream colored, fleshy substance commonly called dead men's fingers. The protruded polyp is an elevated tubular column of translucent substance terminating in an expanded flower of eight slender-pointed petals—the tentacles of the polyp. "The spicules in this creature are of interest, being of varying forms. In *Alcyonium* the sexes are separate, and even the sexes of different colonies are distinct. In any one commonwealth the individuals are either all males or else all females.

The ova and sperm masses are borne on stalked capsules upon the free edges of the mesentaries, or straight bands that run down the tube below the curled up filaments,and development takes place outside the parent.

The embryos are free, swimming by cilia. They soon fix themselves and by continued budding produce colonies." (Hornell.)

STALKED LARVA OF ANTEDON.—This is better known by the name of *Comatula Rosacea*, or "feather-star." Mr. Hornell, in his "Journal of Marine Zoology," describes the delight with which he first pulled up, on a lobster-pot, a colony of this most lovely of star-fishes. I can also recall a red-letter day long ago when I pulled up in a dredge a mass of these beauties in Tar bay, one of the greatest prizes, I think, round our English coast. Its body consists of a disc some half inch across, from which proceed ten long slender arms, bearing numerous pinnules on either side. These often reach 3½ inches, so that the creature has a span of 7 inches.

The sexes are separate, and the genital organs are situated not in the body disc, but in the tiny pinnules of the arms. The fertilized ova are set free as barrel-shaped embryos which acquire four encircling bands of cilia. Next appear a few minute calcareous plates within this embryo, forming as it were, a tiny cask set upon a tiny stalk.

Free swimming life being now almost ended, a disc containing a perforated plate appears on the lower extremity of the stalk; and by this attachment is made to any object that happens to be in the way. The soft, barrel-shaped mass of the swimming larva has now shrunk and adapted itself to the form of the enclosed calcareous skeleton, and the creature is fairly launched upon the stalked and anchored period of its life. In this stage the skeleton is made up of a basal plate, rooting the animal to its host, a considerable number of joints set end to end forming a stalk upon which is seated the cup-shaped frame-work of the body, consisting of two circles of large perforated plates, respectively the "basals" and "orals."

The former form the base of the cup, and the latter the upper ones. Growth after this is rapid; other circles of plates appear, the ten arms proceed from one of the circles, the top joint enlarges into a plate-like structure and develops claw-like jointed organs, the cirri. The body breaks off from its stalk and becomes free to creep among the rocks at will, or swim gracefully with rythmic beats of its long feather-like arms. Special interest attaches to this beautiful creature from tht great part played by its relations, if not its ancestors, which lived during former periods of the earth's history, for the Encrinites, whose remains contributed to greatly build up the huge masses of our mountain limestones, were but gigantic Pentacrinoids of structure practically identical with the stalked larva of the *Antedon* (*Hornell*). Dr. Carpenter's "Microscope" has a good plate of the rosy feather-star. My remarks have been largely taken from "Gosse" and from Cassells "Natural History." also from Hornell's "Journal of Marine Zoology."

Origin of English Scientific Societies.

From SCIENCE-GOSSIP.

At the opening meeting of the 147th Session of the Society of Arts, held on November 21st, 1900, the address given was by Sir John Evans, K. C. B., D. C. L., LL.D., Sc. D., F. R. S., upon the "Origin, Development, and Aims of our Scientific Societies."

Sir John Evans stated that no learned Society had received a Royal Charter before 1662, when the Royal Society was incorporated. The Society of Antiquaries was however, much older, having been founded about 1572. Among the meeting places of this staid and respectable body was the "Young Devil" tavern in Fleet Street. The Society before which the address was given was founded in 1754, and incorporated nearly a century later, in 1847, as the "Society for the Encouragement of Arts, Manufactures and Commerce." From the trio of Societies—the Royal, Antiquaries and Arts—Sir John mentioned that, nearly all the numerous leading learned societies in existence in this country had sprung by a natural process of evolution. The first, perhaps, was the Medical Society, founded in 1773. The Linnean Society for the cultivation of Natural History followed in 1788. The lecturer pointed out that during the century now drawing to its close the vast advances in science and the innumerable aspects which it assumed had led to the foundation of the numerous scientific societies with more or less limited scope. These were by no means confined to science as represented by the ordinary acceptance of the word, as many were literary and philosophical in their aims; that of Manchester dating back to 1781. The offshoots of the Society of Antiquaries had not been so numerous, nor so important, as those from the Royal Society; the field of archæological research being more restricted than that of pure "natural knowledge." The Society of Arts was the first in England to devote attention to the important subjects of forestry and agriculture ; the Royal Agricultural Society not originating until 1838. It was the Society of Arts also that laid the foundation for the Institute of Civil Engineers and its offshoots. At the Society of Arts in 1841 there was formed the Chemical Society, from which arose the Institute of Chemistry in 1877. The same birthplace may be claimed for the Society of Chemical Industry and the Sanitary Institute. Similarly originated were the City Guilds Institute and even the Science and Art Department at South Kensington, though the latter was influenced by the Great Exhibition of 1851. The Photographic Society grew from an exhibition of photographs, the first of its kind, held in the Society's rooms.

It was also the parent of the Royal College of Music. Sir John Evans pointed to the fact that without our Societies it would have been impossible for knowledge to have progressed as it has during the past century. They bring about that healthy competition which stirs men from rest or torper; a state once described by the secretary of the Society of Antiquaries, when he said; "Would to God there was nothing in the world older than a new-laid egg."

Bacteriological Notes.

BY THE EDITOR.

IMPROVED CULTURE MEDIUM FOR GONOCOCCUS.—Tubes of gelose are melted, and cooled to 40° C.. Half the volume of blood—drawn directly from the artery of a rabbit—is added to the tubes of gelose, which are cooled in a slanting position. The growth of the gonococcus in this medium is very rapid, characteristic colonies being present in twenty-four hours.—*Annales Dermatologie.*

BACTERIA IN THE ARCTIC REGIONS.—Some interesting facts concerning the freedom of the air, water, and even the intestinal contents of animals of Arctic regions, from bacteria are communicated by Dr. Levin, of Stockholm, (*Annales de 'l Institut Pasteur*) who took part in the Natthorst expedition during the summer of 1898. Working each time with 20,000 liters of air, he found practically no bacteria. Sea-water, snow and ice yielded on an average one bacterium per 11 c.c. In twelve samples of brown mud he found only a single bacterium. The intestinal contents of polar bears, eider ducks and other birds, sharks, sea urchins, anemones, and crabs were nearly always sterile. Not only did he obtain no growths, but he was unable to find evidence of the presence of bacteria after staining the intestinal contents with the usual agents. The results confirm the conclusions of Nencki, Nuttall and Theirfelder concerning the presence of bacteria as a non-essential factor in digestion.—*American Journal of the Medical Sciences.*

A NEW BACILLUS FROM VACCINE LYMPH.—Nakanishi (*Centralbl. f. Bakt.* Bd. xxvii, No. 18) describes a bacillus which he finds constantly present in vaccinia pustules, and which he has experimentally investigated. This is present in the epithelial cells of the "vaccine pulp" of calves, either as a rod-shaped form, staining in a bipolar fashion, or as a sperical or oval form taking the stain less perfectly. In the lymph from children, on the other hand, the rod-form is not found, but large, round refractive organisms are present, similar to those found in calf lymph, which are looked upon by the writer as variation forms of the bacillus. Pure cultures of the bacillus were obtained on agar plates both from the calf lymph and from lymph drawn from seven-days-old vesicles on the arms of children. The organism grows but on solidified blood-serum, and resembles morphologically, the diphtheria and the so-called pseudo-diphtheria bacilli ; it is a facultative anaerobe.

PNEUMOCOCCIC ARTHRITIS.—A case of pneumococcic arthritis with fatal termination has recently been reported. The illness began as an ordinary pneumonia and was later complicated by an arthritis of the left shoulder. After death, possibly within one hour, the skin over the deltoid muscle was seared with a hot iron and a sterilized needle was thrust into the joint. A syringeful of thick greenish, creamy pus was drawn off. This contained an abundance of pneumococci in pairs and short chains of three or four elements, distinctly encapsulated and in pure culture. The leucocytes were polynuclear. The cocci stained well by Gram's method, and when stained by Ziehl's solution and partly decolorized in one per cent acetic acid, the capsules were very well shown. Typical dew-drop cultures were obtained on agar and blood serum. Its virulence to mice or rabbits was not tested.

RAY FUNGUS.—R. J. Godlee, detailing a series of cases of Actinomycosis, in London *Lancet*, says: To the clinician the first sight of the fungus is usually obtained in the pus evacuated from an abscess, or in the expectoration, and it is visible to the naked eye as small, round granules, sometimes very minute, sometimes larger, oftenest of a pale yellow color, but sometimes white, which are easily demonstrated by allowing the pus, or expectoration to flow down the side of the test-tube while it is held up to the light, or to run over a microscopic slide.

They have been compared to particles of iodoform, but they are obviously rounded and not of such a bright yellow color. One should always be on the *qui vive* and get into the habit of looking at the pus from any abscess of doubtful origin from this point of view, but especially if, on opening the abscess, the amount of pus was less than was expected and the finger passes into an indefinite soft mass which bleeds with great freedom. The sensation imparted to the finger is very characteristic when one is accustomed to it. The hemorrhage suggests what is the fact, that the growth does not interfere with vessels and is in itself very vascular. If a yellow granule be placed unstained in a little water on a slide and the cover-glass be gently pressed upon it, it will be seen under a low power to be made up of rounded masses which are yellowish on the circumference, but less colored in the centre. Under a high power the centre is seen to consist of a densely felted mass of threads which is called the mycelium, and the circumference to contain the so-called clubs which, from their radiated arrangement, have given the name to the fungus.

In some cases, however, these are not to be seen. It must not be supposed that the mycelium is made up of well-defined threads like the mycelium of a mould or a mushroom. It consists of extremely delicate branched threads in which a double outline is scarcely to be distinguished, and which sometimes appear to be made up only of chains of cocci, which has suggested the latest name for the organism, "streptothrix actinomyces." We are told that the organism is easily grown on various media and that it then consists at first of these threads, which after sometime end in chains of streptothrix, which are supposed to constitute the spores of the fungus. At all events these, if transferred to another medium, bud out into the threads of the so-called mycelium. The clubs are very seldom if ever produced in artificial cultures. In old cultures bulbous ends to the threads are sometimes observed, and it is held that the clubs are only produced when the organism is growing under difficulties.

Although it is practically certain that the organism grows on cereals and grass, very little is known of life-history as a vegetable parasite. It is, however, quite certain that it gains access to the bodies of men and beasts on pieces of corn or grass which either stick in the teeth, or mouth, or are swallowed or inhaled—the moral of which ought to be, that we should give up the tempting habit of chewing fresh corn, sucking straws or putting pieces of fresh grass into our mouths. We cannot help inhaling the dust of a threshing-machine and are most likely exposed to the inroads of this pestilent organism in a thousand ways which it is impossible to guard against. Once settled in the mucous membrane of the mouth, oesophagus, alimentary tract, or respiratory passages, it begins to grow and creates inflammation. Sometimes an ulcer is produced, sometimes a sort of tumor, and it is usually the latter condition that the surgeon is called upon to treat or the pathologist to examine. The tumor is of a pale yellowish color, globular in shape, riddled with holes of a larger or smaller size containing pus, and very vascular, although it presents a superficial resemblance to the interior of a tuberculous or gummatous deposit. It infiltrates all the tissues with which it comes in contact, spreading in the intermuscular planes and to some extent into the muscles, extending far and wide into the calcareous structure of bones, occupying extensive portions of the solid viscera and forming communications between the hollow viscera.

It sometimes attacks the skin, sometimes it is met with in the lymphatic glands and occasionally it is distributed to distant parts of the body by the vascular system, exactly as in embolic pyemia ; it is then found in the brain or joints, or indeed any part of the body.

The younger forms are wedge or "candle-flame" shaped; others are rod-shaped,and in old cultures, club-shaped and rounded forms are common. Experimental inoculations in calves and guinea-pigs were negative. In rabbits, intra-peritoneal inoculations were also negative in result, but ulceration is produced by inoculation of the cornea, and in the epithelial cells of this, round or oval bodies are found. These are identical with the bodies described by Guinieri and Pfeiffer in the corneal tissue inoculated with vaccine lymph, and in the corneal vesicles in variola, and which were considered by them to be probably protozoa. By inoculation of cultures of the bacillus into the arms of several children, a student, and himself, the writer was successful in producing typical vesicles. Two other students gave no reaction; possibly they were immune. He argues that the described bacillus is in all probability the specific agent in vaccinia, but with regard to the round and oval forms found in the corneal epithelium, he hesitates to decide whether they are really varieties of the bacillus so modified by the unfavorable site on which they are growing or whether they are degeneration foci in the epithelial cells themselves. The fact that somewhat similar shapes are found in old cultures seem to give countenance to the first view. Much evidence has been collected to show that the protozoa of Guianieri, the so-called cytorrycytes variolæ, are characteristic and specific and as the writer has produced identical forms by inoculation of cultures of this bacillus, he deduces that the bacillus is characteristic of small-pox lymph, and in all probability is the exciting factor in small-pox itself. Further, as the organism resembles the diphtheria bacillus, he draws a parallel between this disease and variola clinically and pathologically, and finds close analogies.—*British Medical Journal.*

METHOD OF DISTINGUISHING COLONIES OF TYPHOID BACILLI FROM THE COLON BACILLUS.—Dr. J. A. Case (Philadelphia *Medical Journal*; *Indiana Lancet*) describes a specially prepared culture medium recommended by Piorkoski. This is made by taking 100 parts of urine that has undergone ammoniacal fermentation, to which is added 0.5 parts of peptone and 3.3 parts gelatin. The whole is heated over a water-bath for one hour, then filtered, placed in test-tubes and sterilized in the usual manner. The sterilization is repeated for ten minutes on the following day. To make the test, the stool of a patient is first rubbed up in a mortar, and three tubes taken, which are inoculated as follows: The first tube by the contents of two platinum loops; the second tube is inoculated from the first, using four loops, and the third by six or eight loops from the second dilution. The contents of each tube is then poured into Petri dishes and placed in a cool place until the gelatin is solidified; it is then placed in an oven and kept at a temperature of 22° C. for twenty-four hours. At the end of this time the typhoid colonies are seen as transparent, filamentous bodies, along side of the coli colonies, which are rounded, with well defined edges. According to the writer, Piorkoski claims to have found the typhoid colonies as early as three days after the beginning of the illness, and he furthermore claims that they may be demonstrated in every case. Twenty-six cases have been tested, in all of which the results of the test were confirmed by the subsequent clinical history.—*Modern Medicine.*

A NEW PATHOGENIC MOULD.—W. H. Ophuls and H. C. Moffitt in the Philadelphia *Medical Journal* present a preliminary report of a new pathogenic mould which was formerly described as a protozoon under the name *coccidiodes immitis pyogenes.*

The patient from whom the organism was obtained was a farm laborer aged nineteen, whose sickness began with a chill, eleven weeks before admission to the hospital.

After a few days the left pleura was tapped and a large quantity of clear fluid was removed. The patient had an irregular fever, the temperature at times reaching 104 ° F. The Diazo reaction was present, but not the Widal. About four weeks after the onset of his trouble, painful inflammation of the knees, elbows, wrists and ankles developed. Later, there was a fluctuating swelling over the left eye, and a large gland developed in the supraclavicular fossa. There was cough, with muco-purulent and occasionally bloodstained sputum. There were no tubercle bacilli in the sputum. The lungs were irregularly consolidated. There was bronchial breathing and harsh and dry rales. The heart was enlarged, but otherwise normal.

The leucocyte count was seventeen thousand. The patient died, ten days after admission, about twelve weeks after the onset of the disease. The autopsy showed acute bronchial pneumonia, abscesses of the retro-peritoneal lymph glands, and encapsulated empyema, enlarged and softened spleen, with colloid swelling of the liver and kidneys. In all the diseased parts that were examined there were found peculiar parasitic organisms, which in the few recorded cases, have been described as protozoa. The life history of these parasites shows the youngest forms as small, spherical masses of protoplasm enveloped in a membrane. The protoplasm is granular, stains well and is occasionally vacuolated. The organism sometimes attains a diameter of thirty micromillimeters and is allways perfectly spherical.

When the adult stage is reached, the capsule breaks, and one hundred or more spore-like bodies are detached. Locomotion was never observed in the adult forms, nor in the spores. The close resemblance of these spores to coccidia, led to their classification as protozoa.

The lesions produced by their presence in the human body, are chronic suppurating processes. The organism grown upon agar-agar, showed mycelia. Inoculated into guinea pigs, it caused suppurating foci, and the same mould was recovered as had been noted in the patient. The organism was found to develop mycelia, when free in a culture medium such as a hanging drop of bouillon. —*Medicine.*

Medical Convention.—The annual meeting of the Medical Society of the State of New York was held at Albany, Jan. 29, 30, 31, 1901. Full particulars from A. M. Phelps, M. D., 62 East 34th Street, N. Y. City.

MICROSCOPICAL SOCIETIES.

Quekett Microscopical Club.—The 380th ordinary meeting of this club was held on Friday, Oct. 19, at 20 Hanover-square. Mr. George Massee, F. L. S., president, in the chair. Messrs. Swift exhibited their new portable microscope as shown at a previous meeting, with the addition of their roller detachable mechanical stage and a sub-stage condenser for use with the lower powers, and of such a focus as to give dark-ground illumination through a fairly thick water trough.

Mr. D. J. Scourfield exhibited and described Mr. Ashe's camera-lucida, a form of Beale's well-known form, but which, by the introduction of a small mirror, obviates the drawback of the latter instrument, which inverts but does not transpose the image. Moreover, the drawing can be made at any angle of inclination of the microscope by the use of an inclinable table for the paper. Mr. Lewis communicated some interesting observations made by Mr. E. G. Wheler, on "A Remarkable Stigmatic Organ in the Nymph of Ornithodorus Megnini," and also on "Ixodes tenuirostris." Specimens and drawings were exhibited, Mr. D. J. Scourfield read a paper on "The Swimming Peculiarities of Daphnia and its Allies, with an account of a New Method of Examining Living Entomostraca, &c."

NEW PUBLICATIONS.

Laboratory Directions for Beginners in Bacteriology. Moore, Veranus A. Boston. Ginn & Co., 1900. The cordial reception tendered to the first edition of Dr. Moore's Laboratory Directions for Beginners in Bacteriology has caused the author th prepare a second edition. This edition is somewhat extended, and the literature thoroughly sifted. The course is certainly an excellent one and for a course of medium length has enough details to give the student a comprehensive idea of the subject. The work can be recommended most cheerfully to those pursuing a course in bacteriology.—L. H. PAMMEL.

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Recent Knowledge of the Bubonic Plague.

BY WILLIAM C. DOBSON, M. D.

This article includes also a review of the recently published *Text-Book upon the Pathogenic Bacteria, for Students of Medicine, and Physicians*, By Joseph McFarland, M. D., Professor of Pathology in the Medico-Chirurgical College, Philadelphia. Third Edition, Revised and Enlarged. 8vo. pp. 621. Illustrated with 142 Engravings and 3 plates. Philadelphia, W. B. Saunders & Co. 1900. Price $3.25 net.

Part I of this work devotes a chapter to each of the following subjects, viz. Bacteria; Biology of Bacteria; Infection and Intoxication; Immunity and Susceptibility; Methods of Observing Bacteria; Sterilization and Disinfection; Cultivation of Bacteria; Cultures and their Study;

The Cultivation of Anaerobic Bacteria; Experimentation upon Animals; The Recognition of Bacteria; Bacteriologic Examination of the Air; Bacteriologic Examination of Water; Bacteriologic Examination of Soil.

Part II Considers Specific Diseases and Their Bacteria. This division includes The Phlogistic Diseases, both acute and chronic; The Toxemias; The Bacteremias; Miscellaneous diseases which are not included in the foregoing classifications. The Acute Inflammatory Diseases of Suppuration, Gonorrhoea, Mumps, Cerebro-spinal Meningitis and Pneumonia are ably handled and the chapters devoted to Tuberculosis, Leprosy, Glanders, Syphilis, Actinomycosis, Mycetoma, Farcin du Boeuf and Rhino-scleroma are of especial interest. The Toxemias of Tetanus, Hydrophobia, Diphtheria and Cholera, are brilliantly treated and lead to special articles upon Anthrax, Typhoid Fever, Yellow Fever, Chicken-cholera, Hog-cholera, Swine-Plague, Typhus Murium, Mouse-Septicemia, Relapsing Fever, Bubonic Plague, Tetragenus, Influenza, Measles and Malta Fever, which are calculated to show the education, research and experience of the author. The illustrations are admirably executed and the text excellent, two qualities, which when combined with scholarly classification, tend to produce a volume, of which the publisher may justly feel proud. We are pleased to quote at length from the article on *Bubonic Plague;* which disease is caused by the *Bacillus Pestis Bubonicae.*

Plague, malignant poly-adenitis, is an acute febrile disease of an intensely fatal nature, characterized by inflammation of the lymphatic glands, marked cerebral and vascular disturbance, and the presence of the specific bacillus in the lymphatic glands and blood. The bubonic plague is an extremely fatal disease, whose ravages in the hospital in which Yersin made his observation, carried off 95 per cent of the cases. The death-rate varies in different epidemics from 50-90 per cent. In the epidemic at Hong

Kong in 1894 the death-rate was 93.4 per cent for Chinese; 77 per cent for Indians; 60 per cent for Japanese; 100 per cent for Eurasians, and 18.2 per cent for Europeans.

It affects both men and animals, and is characterized by sudden onset, high fever, prostration, delirium, and the occurrence of lymphatic swellings—buboes—affecting chiefly the inguinal glands, though not infrequently the axillary, and sometimes the cervical, glands. Death comes on in severe cases in forty-eight hours. If the case is of longer duration, the prognosis is said to be better. Autopsy in fatal cases reveals the characteristic enlargement of the lymphatic glands, whose contents are soft and sometimes purulent. Wyman in his very instructive pamphlet, "The Bubonic Plague," finds it convenient to divide plague into (a) bubonic or ganglionic; (b) septicemic; and (c) pneumonic forms. Of these the bubonic form is most frequent and the pneumonic form most fatal. The infection usually takes place through some peripheral lesion, but may occur by inhalation of the specific organisms. The bacillus of bubonic plague seems to have met an independent discovery at the hands of Yersin and Kitasato in the summer of 1894, during the activity of the plague then raging at Hong Kong. There seems to be but little doubt that the micro-organisms described by the two observers are identical. The bacillus is short and thick—a cocco-bacillus, as some call it—with round ends. Its size is small (2 mm. in length) and its form is subject to considerable variation. It not infrequently occurs in chains of four or six or even more, and is occasionally encapsulated. It shows active Brownian movement, which probably led Kitasato to consider it motile, while Yersin did not.

Gordon found that some, at least, of these plague bacilli have flagella. It is an ærobic organism. No spores are formed. It stains well by the usual method; not by Grams method. When stained the organism appears darker at the ends than at the centre, so as to resemble a dumbbell or diplococcus. The bacilli sometimes appear vacuolated and in old cultures show a variety of involution-forms. Kitasato has compared the bacillus to that of chicken cholera. In his studies of plague, Ogata states that while Kitasato found the bacillus which he had described, in the blood of cadavers, Yersin seldom found his bacillus in the blood, but always in the enlarged lymphatic glands. Kitasato's bacillus retains the color when stained by Gram's method ; Yersin's does not. Kitasato's bacillus is motile ; Yersin's, non-motile. The colonies of Kitasato's bacillus when grown upon agar are round, irregular, grayish-white with a bluish tint, and resemble glass-wool when slightly magnified ; Yersin's bacillus forms white, transparent colonies with iridescent edges. Ogata, in the investigation of the cases that came into his hands, found a bacillus that resembled that of Yersin, but not that of Kitasato, and it is certain that the description of Yersin is the more correct of the two.

In the *Japan Times*, 1899, Kitasato explains that his investigations being made upon cadavers that were partly putrefied, he was led to believe that the bacillus first invaded the blood. Later studies upon living subjects, showed him the error of this view and the correctness of Yersin's observation that the bacilli first multiply in the lymphatics. The studies of Kitasato and Yersin show that in blood drawn from the finger tips and in the softened contents of the glands, the bacillus may be demonstrable. When cultures are made from the blood or softened contents of the buboes, the bacillus may be obtained in pure culture, and is found to develop upon artificial culture-media. In bouillon, a diffuse cloudiness results from the growth, as observed by Kitasato, though in Yersin's observations the culture more nearly resembled erysipeles cocci, and contained zooglea attached to the sides and at the bottom of the tube of nearly clear fluid. According to Haffkine, when an inoculated bouillon culture is allowed to stand perfectly at rest, on a solid shelf or table, a characteristic appearance developes. In from twenty-four to forty-eight hours, the liquid remaining limpid, flakes appear underneath the surface, forming little islands of growth, which in the next twenty-four to forty-eight hours grow down into a long stalactite-like jungle, the liquid always remaining clear. In four or six days the islands are still more compact and solidified. If the vessel be disturbed, the islands fall like snow and are deposited at the bottom, leaving the liquid above clear. Upon the gelatin plates at 22°C. the colonies may be observed in twenty-four hours by the naked eye. They are pure white or yellowish white, spherical in the deep gelatin, flat upon the surface, and are about the size of a pins' head. The gelatin is not liquefied.

The borders of the colonies are, upon microscopic study, found to be sharply defined and to become more granular as their age increases. The superficial colonies occasionally are surrounded by a fine, semi-transparent zone. In gelatin puncture-cultures the development is scant. The medium is not liquefied; the growth takes place in the form of a fine duct, little points being seen on the surface, and in the line of puncture. Sometimes fine filaments project into the gelatin from the central puncture. Upon agar-agar the bacilli grow freely but slowly, the the colonies being whitish in color, with a bluish tint by reflected light, and first appearing to the naked eye when cultivated from the blood of an infected animal, after about thirty-six hours incubation 37 °C. Under the microscope they appear moist, with rounded, uneven edges.

The small colonies are said to resemble little tufts of glass-wool, the larger ones have large round centres. Microscopic examinations of the bacilli grown upon agar-agar, reveals the presence of long chains resembling streptococci.

Upon glycerin-agar the development of the colonies is slower, though in the end the colonies attain a larger size than those grown upon plain agar. Klein says that the colonies develop quite readily upon gelatin made from beef-bouillon (not infusion), appearing in twenty-four hours at 20° C. as small gray, irregularly rounded dots. Magnification shows the colonies to be serrated at the edges and made up of short, oval, sometimes double bacilli. Some colonies contrast markedly with their neighbors in that they are large, or looped threads of bacilli.

The appearance was much like that of the young colonies of the Proteus vulgaris. At first these were regarded as contaminations, but later he was led to believe that their occurrence was characteristic of the plague bacillus. The peculiarities of these colonies cannot be recognized after forty-eight hours. Involution-forms on partly desiccated agar-agar not containing glycerin, are said by Haffkine to be characteristic. The microbes swell up and form large, round, oval, pea- or spindle-shaped or biscuit-like bodies, which may attain twenty times the normal size, and in growing, gradually lose the ability to take up the stain. Such involution-forms are not seen in liquid culture. Hankin and Leumann recommend for the differential diagnosis of the plague bacillus, the addition of 2.5 to 3.5 per cent of salt to the agar-agar. When transplanted from the ordinary agar-agar to the salt agar-agar, the involution-forms which are so characteristic of the plague bacillus, form with exceptional rapidity. In bouillon with this high percentage of salt, the stalactite formation is very beautiful and characteristic. Upon blood-serum, the growth at the temperature of the incubator is luxurient. It forms a moist layer of a yellowish-gray color, and is unaccompanied by liquefaction of the serum. Upon potato, no growth occurs at ordinary temperature.

When the potato is put for a few days in the incubator, a scanty, dry, whitish layer develops. Abel found the best culture medium to be 2 per cent alkaline pepton solution with 1 or 2 per cent of gelatin, as recommended by Yersin and Wilson. The bacillus develops under conditions of aerobiosis and anærobiosis. In glucose-containing media it does not form gas. No indol is formed. Ordinarily the culture-medium is acidified by the development of an acid that persists for three weeks or more. By frequent passage through animals of the same species,the bacillus increases very much in virulence. Curiously enough, however, the observations of Knorr, substantiated by Yersin, Calmette, and Borrel, show that the bacillus made virulent by frequent passage through mice,is not increased in virulence for rabbits. Mice, rats, guinea-pigs rabbits, monkeys, dogs and cats are all susceptible to inoculation. During epidemics, the purely herbiverous animals usually escape, though oxen have been known to die of the disease. When blood, lymphatic pulp, or pure cultures are inoculated into them, the animals become ill in from one to two days, according to their size and the virulence of the bacillus. Their eyes become watery, they begin to show disinclination to take food or to make any bodily effort, the temperature rises to 41.5°C., they remain quietly in a corner of the cage, and die with convulsive symptoms in from two to seven days. If the inoculation was intravenous, there is no lymphatic enlargement, but if it was subcutaneous, the nearest lymph-nodes are always enlarged, and, in cases with delayed death, suppurated. The bacilli are found everywhere in the blood, but not in very large numbers.

Devell has found that frogs are susceptible to the disease. Wyssokowitz and Zabelotny found monkeys to be highly susceptible to plague, especially when inoculated subcutaneously. When so small an inoculation was made as a puncture with a pin, dipped in a culture of the bacillus, the puncture being made in the palm of the hand or sole of the foot, the monkeys died in from three to seven days. In these cases, the local edema observed by Yersin, did not occur. They point out the interest attaching to infection through so insignificant a wound and without local lesions. According to Yersin, an infiltration of watery edema can be observed in a few hours, about the point of inoculation. The autopsy shows the infiltration to be made up of a yellowish gelatinous exudation. The spleen and liver are enlarged, the former often presenting an appearance, much like an eruption of miliary tubercles. Sometimes there is universal swelling of the lymphatic glands. Bacilli are found in the blood and in all the internal organs. Very often there are eruptions during life, and upon the inner abdominal walls there are petechiæ and occasional hemorrhages. The intestine is hyperæmic, the adrenals congested. There are often sero-sanguinolent effusions into the serous cavities.

Klein found the intra-peritoneal injection of the bacillus into guinea-pigs,of diagnostic value, producing in twenty-four to forty-eight hours a thick, cloudy peritoneal exudate, rich in leucocytes and containing characteristic chains of the plague bacillus. Animals fed upon cultures or upon the flesh of other animals dead of the disease, became ill and died with typical symptoms. When Klein inoculated animals with the dust of dwelling houses in which the disease had occurred, some died of tetanus, one from plague. Many rats and mice in which examinations showed the characteristic bacilli, died spontaneously in Hong-Kong. Yersin showed that flies also die of the disease. Macerating and crushing a fly in bouillon, he not only succeeded in obtaining the bacillus from the medium, but infected an animal with it. Nuttall in reviewing Yersin's fly experiment, found the statement true, and showed that flies fed with the cadavers of plague infected mice, died in a variable length of time. Large numbers of plague bacilli were found in their intestines. He also found that bed-bugs allowed to prey upon infected animals, took up large numbers of the plague bacilli and retained them for a number of days. These bugs did not, however, infect healthy animals when allowed, subsequently, to feed upon them. Nuttall is not, however, satisfied that the number of his experiments upon this point was great enough to be conclusive. Ogata found that the plague bacillus existed in the bodies of fleas found upon diseased rats. One of these he crushed between sterile object-glasses and introduced into the subcutaneous tissues of a mouse, which died in three days with typical lesions of the plague, a control animal remaining well.

The guinea-pigs taken for experimental purposes into a plague district, and kept carefully isolated, died spontaneously of the disease, presumably because of insect infection. The animal most prone to spontaneous infection seems to be the rat, and there is much evidence in support of the view, that it aids in the spread of epidemics. At several of the Asiatic plague districts and at Santos the appearance of plague among the inhabitants was preceded by a large mortality among the rats, some of which when examined, showed bubœs and had died of plague-septicemia. It is rather improbable that men become infected with plague through the bites of the fleas, leaving the bodies of plague-destroyed rats, as was once supposed. Galli-Valerio thinks the fleas of the mouse and rat are incapable of living upon man and do not bite him, and that it is only the *Pulex irritans*, or human flea, that is capable of transmitting the disease from man to man. Yersin found that when cultivated for any length of time upon culture media, especially agar-agar, the virulence was rapidly lost and the bacillus eventually died. On the other hand, when constantly inoculated from animal to animal, the virulence of the bacillus is much increased.

The bacillus probably attenuates readily. Kitasato says that it did not seem able to withstand dessication, longer than four days; but Rappaport (quoted by Wyman) found that they remained alive when kept dry upon woolen threads at 20 °C. for twenty-three days and Yersin found that although it could be secured from the soil beneath an infected house, at a depth of 4-5 cm., the virulence of such bacilli was lost. Kitasato found that the bacilli was killed by two hours exposure to 0. 5 per cent. carbolic acid, and also by exposure to a temperature of 80 °C. for five minutes. Ogata found that the bacillus was instantly killed by 5 per cent carbolic acid, and in fifteen minutes by 0.5 per cent carbolic acid. In 0.1 per cent sublimate solution it is killed in five minutes. According to Wyman, the bacillus is killed by exposure to 55° C. for ten minutes. The German Plague Commission found that the bacilli were killed by exposure to direct sunlight for three or four hours; and Bowhill found that they were killed by drying at ordinary room temperatures in about four days. It seems possible to make a diagnosis of the disease in doubtful cases by examining the blood, but it is admitted that a good deal of bacteriologic practice is necessary for the purpose. Abel finds that the blood may yield fallacious results because of the rather variable appearance of the bacilli, which are sometimes long, and easily mistaken for other bacteria. He deems the best tests to be the inoculation of broth cultures and subsequent inoculation into animals, which he advises should have been previously vaccinated against the streptococcus.

Plague bacilli persist in the urine a week after convalescence. Wilson, of the Hoagland Laboratory, found the thermal death-point of the organism was one or two degrees higher than that of the majority of pathogenic bacteria of the non-sporulating variety, and that, unlike cholera, the influence of sunlight and desiccation cannot be relied upon to limit its viability. Dr. Kitasato's experiments first showed that it is possible to bring about immunity to the disease, and Yersin, working in India, and Fitzpatrick in New York, have successfully immunized large animals (horses, sheep, goats). The serum of these immunized animals contains an antitoxin capable not only of preventing the disease, but also of curing it in mice and guinea-pigs and probably in man. Haffkine in his experiments followed the line of preventive inoculation as employed against cholera. Bouillon cultures were used, in which floating drops of butter were employed to make the islands of plague bacilli float. The cultures were grown for a month or so, successive crops of the island-stalactite growth as it formed, having been precipitated by agitating the tube. In this manner there was obtained an "intense extra-cellular toxin" containing large numbers of the bacilli. The culture was killed by exposure to a temperature of 70 °C. for one hour, and the mixture used in doses of about 3 c.cm. as a preventive inoculation.

A most interesting collection of statistics, showing in a convincing manner the importance of the Haffkine prophylactic, is that of Leumann of Hubli. The figures, together with a great deal of interesting information upon the subject, can be found in the paper upon "A Visit to the Plague Districts in India" by Barker and Flint. The immunity conferred by the Haffkine prophylactic in doses of 1 c.cm. is of considerably longer duration, lasting about a month. The preparation must not be used if the persons have already been exposed to infection, and is possibly in the incubation stages of the disease, as it contains the toxins of the disease and greatly intensifies the existing condition. When injected into healthly persons it always produces fever, local swelling and malaise. Wyssokowitz and Zabolotny, whose studies have already been quoted, used 96 monkeys in the study of the value of the "plague-serums," and found that when the treatment has begun within two days from the time of inoculation, the animals can be saved, even though symptoms of the disease are marked. After the second day, the treatment cannot be relied upon. The dose necessary was 20 c. cm. of a serum having a potency of 1 : 10. If too little serum was given, the course of the disease was slowed, the animal improved for a time and then suffered a relapse, and died in from thirteen to seventeen days. The serum also produced immunity, but of only ten to fourteen days duration.

An immunity lasting three weeks was conferred by inoculating a monkey with an agar-agar culture heated to 60 °C. If too large a dose of such a culture was given, however, the animal was enfeebled and remained susceptible. Of Yersin's serum, which is prepared by immunizing horses in the usual manner to toxins and cultures of the bacillus, 5 c. cm. doses have been found to confer an immunity lasting for about a fortnight. Larger doses confer a longer immunity. For the treatment of the developed disease, enormous doses of 50 and even 100 c. cm. seem to be necessary to produce the desired results, evidently indicating that the serums thus far obtained are weak.

BIOLOGICAL NOTES.

L. H. PAMMEL.

Auto-intoxication and Spyrogyra.—In a recent number of the American Journal of the Medical Sciences, Dr. Klingmann makes some interesting statements with reference to auto-intoxication and toxic states of blood. He has experimented with protozoæ and algæ, which were treated with various toxic substances. The alga used was Spirogyra. After describing briefly the normal peculiarities of Spirogyra, he shows that toxic substances like those produced in certain contagious diseases, and those following epilepsy, produced certain pathological changes in the Spirogyra.

"The water which is used for diluting the blood is tested by placing a few threads of Spirogyra in a glass dish containing some of the water, and is allowed to stand for a few minutes ; if the water is non-toxic the specimen remains unchanged. The time in which the change will occur varies directly with the amount of toxin present and the species of Spirogyra used. In one case it was found that reaction took place after diluting the blood with five litres of water. In this way it can be determined whether the toxicity of the blood has increased or diminished. It was repeatedly observed that in testing the blood of patients who were convalescing, the time in which the reaction took place was greatly prolonged; in one case of diphtheria, this was noticed after two injections of antitoxin. In all cases examined, except those suffering from acute or chronic alcoholism and gout and rheumatism, a division of the protoplast of the spirogyra took place; in the cases of alcoholism, rheumatism and gout, the reaction was not the same as that occurring in the other cases, but resembled that described by Naegeli under the second heading; the chlorophyll bands were retracted from the protoplasmic cylinder and changed their general arrangement, and the nucleus changed its position and form." (*Am. Jour. Med. Sci.* 120 : 585.)

KARYOKINESIS.—In the October number of the Popular Science Monthly (57 : 664 : 1900) there is published the retiring address of Sir William Turner as President of the British Association. This paper considers the history of cytology, especially with reference to the multiplication of cells and karyokinesis. Those who are especially interested along this line will find this paper presenting the subject in a most admirable and concise form.

BUBONIC PLAGUE.—In the October number of Popular Science Monthly, (57 : 576. 1900), Dr. Frederick G. Novy discusses the Bubonic Plague. This paper deals chiefly with historical matters showing how the disease has spread to the various parts of the world at different times.

Plant Hybridization.—Mr. Herbert J. Webber who has charge of the plant breeding laboratory of the U. S. Department of Agriculture, has been making some interesting observations along the line of hybridization. Among the other plants studied he has done something with the pineapple ; he finds that some varieties are much more fertile than others. "In my own experience, the most fertile varieties are the Abbaka and Smooth Cayenne, two of the finest varieties known. Ninety-seven flowers of Abbaka crossed with pollen of Smooth Cayenne gave seventy-seven good seeds, and, in the case of the reciprocal cross, thirty-six flowers of the Smooth Cayenne crossed with pollen, Abbaka gave forty-six perfect seeds. Other sorts used in crossing, such as Golden Queen, Ripley, Red Spanish, Mauritius, &c., gave varying degrees of fertility between these two extremes." (Separate Jour. Roy. Hort. Soc. 24.)

Study of Manufactured Starches.—In a recent bulletin of the Division of Chemistry, U. S. Department of Agriculture, Dr. Wiley discusses the manufacture of starch from potatoes and cassava and incidentally refers to the structure of microscopic characters of a number of other starches, and the amount of starch produced in the different plants. He also discusses the methods of manufacture. This paper is accompanied with several excellent plates. (Bull. Div. Chem. U. S. Dept. Agrl. 58.)

Actinocyclus Ralfsii.

EDWARD M. NELSON, F. R. M. S.

The interesting diatom, especially when viewed under a low power, is so transcendentally beautiful that it will attract the attention of even those who, like Gallio, "care for none of these things." The charm in this diatom consists not only in its remarkable system of rays, from which it derives its name, but also in its exquisite coloring.

When, however, this diatom is viewed in a critical manner with a wide-angled oil-immersion lens all its lovely color vanishes and its beautiful rays become so inconspicuous as to be hardly noticeable; in spite of this, however, its interest to a scientist will be rather increased than diminished. It is not difficult to account for the loss of the rays, for when the diatom is examined under a low power, the dots, or more accurately the minute perforations in the silex, are so closely approximated to one another that they appear to run together and form rays, but when this structure is examined under a higher power of greater aperture, these dots are so widely separated that they cease to give this appearance of lines or rays.

The reason for the loss of the color is not quite so obvious, for the color may be produced in a variety of ways e. g. by polarization, by the unequal refraction of light, by diffraction, by the varying thickness of transparent thin plates, and lastly by pigments. Now we know that exceedingly minute objects, such as bacteria and micrococci, when stained by pigments do not lose their color when examined by high powers; but on the other hand, objects such as diatoms, which owe their color to the diffraction of light by their minute structure, change their color from violet to red and finally lose it altogether as the power, or rather the aperture, of the objective is increased. It is an instructive experiment to examine with dark ground illumination and a low-power objective, say one inch or ⅔ inch of aperture .25 to .3 N. A., a slide containing various species of *Pleurosigma* that have different degrees of fineness of structure; the coarser forms will appear ruddy, those a little finer, greenish, those still finer blue, and some finer still, will appear violet or indigo

Now if the lens be changed for one whose aperture is .4 N. A., those that were ruddy will be colorless, and the structure that gave rise to the color will be resolved, those that were green will be ruddy, and those that were blue will have become green, and so on. If a lens of still greater aperture be employed, those that were originally green will become colorless and will be resolved, and the colors of the others will be lowered a step in the gamut. This law, which holds good with other diatoms, quite breaks down with the *Actinocyclus Ralfsii*, for if we examine one on a dark ground with a low power those parts which were brilliantly colored blue with transmitted light now become a golden yellow. Again, all other diatoms lose their color when the structure which gives rise to it by diffraction is resolved, but with *A. Ralfsii* the color remains, although the structure is resolved, and lastly other diatoms when viewed by axial transmitted light appear white, while this is brilliantly colored, provided that a lens of suitable aperture be employed to examine it. The color in this diatom is visible with transmitted light, provided that the aperture of the objective used does not greatly exceed .45 N. A.; the power of the objective or eyepiece is of no consequence, the aperture of the lens is the sole determining factor in the case, as may be proved by manipulating an iris diaphragm at the back of the objective.

There is a slide in my cabinet which contains both an *Actinocyclus Ralfsii* and a *Hyalodiscus stelliger*. This last diatom has an ordinary sieve-like structure of about 35,000 per inch. Now, these two diatoms act in precisely contrary manners, for on a light field with ordinary transmitted light the *Actinocyclus* is brilliantly colored while the *Hyalodiscus* is colorless; but on a dark ground the *Hyalodiscus* is colored, and the *Actinocyclus* colorless. In short, the *Hyalodiscus* follows the rule of all other diatoms, e. g., the *Pleurosigmæ*, *Naviculae*, etc., and behaves precisely like them. In *Actinocyclus Ralfsii* the only part which follows this general diatomic rule is the narrow margin which, with transmitted light, is a golden yellow. (Thsi color may be somewhat erroneously described, as its golden tint may be caused by the contrast with the brilliant blue close to it), but on a dark ground exhibits a blue-green tint ; this is a diffraction color, which like all diffraction colors, turns white on resolution,or more strictly speaking shortly before resolution.

The tint of the diffraction color of a diatom depends upon the aperature of the objective used, and the obliquity of the illumination. By this means we may therefore roughly determine the fineness of any diatomic structure by matching the tint with one whose fineness of structure has been measured, or with a test plate or ruled bands.

Of course it is necessary that the comparison be made with the same objective and under the same conditions of illumination. A suitable illumination for this purpose is daylight, and an achromatic condenser with a central opaque stop, just large enough to give a dark ground.

The question then is : what is the cause of the color in *Actinocyclus Ralfsii* ? Obviously it cannot be a diffraction color arising from the ordinary primary structure forming the "rays," which give the diatom its name, because as we have seen above, when this structure is resolved the color is still visible, and no color arising from diffraction is visible when the diffraction itself is resolved. It cannot be due to pigment, for if it were it would remain visible when the aperture was increased beyond .45 N.A. It cannot be caused by thin plates, because it would require reflected and not transmitted light to render it visible. Polarization and refraction seem quite out of the question ; and as there is no other theory at hand, the answer must for the present be left undetermined.

It was pointed out in 1897 (Journ. Q. M. C., Vol. 6, ser. 2, p. 431) that with an apochromatic $\frac{1}{8}$ of 1.4 N.A., used in connection with a wide-angled oil-immersion condenser giving a large aplanatic cone, a very delicate perforated veil could be seen covering the whole valve of an *Actinocyclus Ralfsii.* This very delicate structure has obviously nothing to do with the color in question, because it would require a far greater aperture than .45 N.A. to develop upon a dark ground, any color arising from the diffraction of so fine a grating ; and this question is quite independent of that concerning the different kind of illumination required to develop the color, a point of which we have as yet found no explanation. If a *Hyalodiscus subtilis* whose structure is about 70,000 per inch, or twice as fine as that of *Hyalodiscus stelliger*, be examined on a dark ground with a lens of .25 N.A. no color will be perceived, while the *H. stelliger* under similar conditions will be brightly colored ; if the aperture be increased to .5 or .6 the *H. stelliger* will be resolved, while the color of the *H. subtilis* will be an intense blue. Now the resolution of the *H. subtilis* may be accomplished with a dry lens of .95 N.A., used critically, but as this lens reveals nothing of the extremely delicate structure we are considering on *Actinocyclus*, it stands to reason that the color, observed in *Actinocyclus* with quite a low aperture and with transmitted light, cannot possibly be caused by this delicate structure. To repeat the argument :—

HYALODISCUS SUBTILIS.

This diatom when viewed upon a dark ground, with a lens whose aperture is .55 N.A., is colored ; the structure which gives rise to this color can be resolved by a dry lens of .95 N.A.

ACTINOCYCLUS RALFSII.

This diatom when viewed by transmitted light, with a lens whose aperture is .25 N.A., is colored ; the color remains when the coarse structure on the diatom is resolved ; a dry lens of .95 N.A., however critically used, is quite unable to resolve the fine veil on this diatom. If this fine veil were the diffractor which caused the coloration of this diatom, it would require a lens with an aperture of at least .55 N.A. to develop the color.

Finally, all diffraction colors vanish with transmitted light, but the color of *A. Ralfsii*, with exception of that on its narrow margin, is only visible with transmitted light.

In this narrow margin the single process or nodule is situated ; this I find has a very finely perforated cap, very similar to those of the Aulisci which have been previously described. The resolution of this detail is exceedingly troublesome, and perhaps it is one of the most difficult images the microscope, as at present constituted, is capable of dealing with.—*The Quekett Club.*

The Limitations of Clinical and Microscopical Evidence.

W. K. JACQUES, M. D., CHICAGO.

To correctly interpret the phenomena of disease and health, one must have a clear conception of the relationship sustained by pathogenic bacteria in the causation of disease. The older bacteriologists, led by the great Robert Koch, believed and taught that germs were the cause of disease, using the word cause in its scientific sense. That is to say, that within the germ are all the elements which are manifest in the effect, disease. This was in direct opposition to the teachings of Virchow's cellular pathology. Between these great leaders and their followers, has waged a long war, with the gradual evolution of the fact that both are partly right.

Disease is a process brought about by many factors, no one of which may be the all sufficient cause,any more than the electric spark may be the all sufficient cause of a dynamite explosion.

The germ is many times the exciting cause, or the last factor added to set the disease process in motion. The Klebs-Lœffler bacillus,the pneumococci and other micro-organisms may be carried in the mouth of a healthy individual for long periods of time without becoming pathogenic, until the individual becomes susceptible through lowered vitality and the disease process is set in motion.

In these cases, predisposition is the last factor added. The germ is not the all sufficient cause, but is an important factor, capable of setting the disease process in motion and of influencing it when other factors are present. It is only when the relationship is recognized, that the limitations of the microscopic and clinical evidence in diagnosis can be understood. A germ disease is where the patient furnishes the conditions under which a germ can multiply and by its presence, or products, disturb the metabolism of the human cells. When the environment of the cells furnishes them with proper conditions, the resulting metabolism is a condition of health.

When there is introduced into this environment anything which depresses or stimulates the metabolism of the cells beyond normal limits, the resulting condition is called disease. Therefore it is important to understand those things which go to make up environment.

Temperature, food, the products of cell activity—such as the ductless glands—and poisons of various kinds, are factors of environment whose presence or absence may cause disease metabolism. The cell, therefore, is the dominent entity of life. From its environment it receives nourishment and the necessary stimulus which causes it to absorb, excrete and reproduce its kind. The bacterial cell does not differ in these essentials from the human cell. It is a living entity and its internal metabolism depends upon its environment. When the pathogenic germ finds in the human body, conditions which permit it to carry on its cycle of activity, its presence becomes a factor in the environment of the human cells, which causes disease metabolism. In the study of infectious diseases, it is important to recognize the individuality of the different pathogenic germs. Each is subject to governing laws, as definite as those concerning the human being.

Each germ by its form and structure and its former environment, possesses individual pathogenic power. All micro-organisms are most susceptible to the environment.

Their life cycle is so short that they are able to adapt themselves to changing conditions much more readily than is possible in the animal cells. What is true of one germ, may or may not be true of another; each has its own range of temperature, food conditions and environment in which it becomes pathogenic or harmless. The effects of environment may be demonstrated by placing germs under different conditions and noting the results.

Most students are familiar with the results of growing the Lœffler bacilli on agar agar and other media. The bacilli of anthrax vary greatly under different conditions.

Prof. Adami has shown how the bacillus colli changes from the bacillus form to the coccus, as it passes through the tissues. Because of these morphological changes, it is difficult to identify germs by form alone. While they may resemble each other in form, they will differ in arrangement, staining qualities, virulence or other conditions. The tissues in which a germ is found growing, may assist in its identification. As knowledge of bacteria progresses, the necessity of not relying upon any one definite quality in identification, becomes imperative. Virulence is even more influenced by environment than form. If the germ metabolism takes place in the presence of free oxygen, the toxin may be oxidized and rendered harmless.

Cholin derived from nerve substance and neurin differ only in a molecule of water. One is but slightly poisonous and the other intensely so. When bacteria are able to break up the highly organized substances of the human body, these atoms at once enter into new combinations under the conditions which then exist. Scientists are realizing the necessity of studying pathogenic germs in the environment in which they produce disease. The student of malaria goes to the swamp, and the investigator of the plague, to Calcutta. In some of the more common germ diseases, it is often important that the microscopical evidence must not be separated from the clinical. The bacteriologist may be able to identify a germ as soon as seen under the microscope, but to be absolutely certain, it is necessary to make cultures and animal tests. The methods are too cumbersome and take too much time for most diagnostic purposes. If the bacteriologist knows the clinical symptoms of the patient at the time the culture was taken, it might remove any uncertainty in the identification of the germ. For instance, a Health Department box was inoculated and sent to a pathological laboratory for examination.

The bacteriologist reported the finding of the diphtheria bacilli. Had the culture been accompanied with the information that it had been inoculated from a healthy vagina, the germ would have been recognized as the bacillus vaginalis. The method of taking the culture is also important. The condition of material sent to the laboratories often shows very careless methods or ignorance of bacteriology. The surface of the medium is scarcely touched with the inoculating swab ; cotton swabs come wrapped in newspaper, envelopes, or dirty bottles. Some of the fluids of the body are destructive to germs. When taking blood for examination, it should be at once diluted by large quantities of broth to prevent it from destroying the germs. It is the verdict of the bacteriologist that swabs from suspected anginas should be used at once to inoculate culture media. If this is not done at once, the action of the saliva may destroy the bacilli and thus prevent the detection of their presence.

For this reason, swabs alone cannot be sent by mail. It must be remembered that culture media furnishes a different environment than the human tissues and modifications in the morphology and virulence of germs may occur. Most students of bacteriology know the variations which occur in the Lœffler bacillus when grown on agar agar and blood serum ; but it is not so well known that serum from bovines, causes a short thick bacillus and that from sheep and dogs, a longer one. The tubercular bacillus has been identified by its staining qualities until now almost without question. The recent work of bacteriologists show that other bacilli not only have the same form but the same staining reaction as the tubercular bacillus.

A smear from the prepuce of a dog and one from tuberculous sputa, both prepared and stained by carbol-fuchsin method will give a similar field. In the diagnosis of pulmonary tuberculosis in its early stages, the limitations of the microscopic examination, if not understood, may result in serious consequences to the patient. At this stage the tubercular foci may not be in a condition to throw the bacilli into the sputum. They may be in such limited numbers, that they can only be found with difficulty.

If a physician depends upon the negative answer of the bacteriologist, he may let the time pass when it is within the power of any help to stay the tubercular process.

The tuberculin reaction in careful hands is of value, but has not yet reached the stage of application needed for use by the general practitioner. It is generally understood that the term diphtheria is applied to that disease which is caused by the multiplication of the Lœffler bacillus in a susceptible individual. The necessity for giving antitoxin early, forces the physician to make a diagnosis as soon as possible. The rapid multiplication of the bacilli at the point of invasion, the peculiar arrangement, the morphology, which is fairly maintained by the bacilli when growing in culture, in a large per cent of cases make the identification of the germ reliable. It has been a great relief for the physician to unload his cares on the shoulders of the bacteriologist. It seems too bad that the latter is getting tired and insists in returning the responsibility to the family physician, where the patient has placed it. All a bacteriologist can say when examining cultures, is that he finds a germ corresponding to the Klebs-Lœffler bacillus. It is for the physician to complete the diagnosis by putting with it the clinical symptoms and to decide whether or not the disease process is in motion.

There is such a wide range in the morphology of the diphtheria bacillus that it is not easy to identify. There are other germs which resemble it so closely that it is sometimes difficult to distinguish them. The Lœffler bacillus may have all grades of virulence. The long variety is the most virulent, yet the short form may be toxic and the non-virulent form cause death by strangulation. The site of the invasion may not be where the germs can be obtained, or antiseptic gargles may have been used.

The culture medium may be contaminated. To properly appreciate the value of microscopical evidence, a physician should be familiar with those conditions which promote accuracy and success. While it would be little short of criminal to discard the use of the microscope in the diagnosis of diphtheria, it should be kept in mind that there are conditions where this evidence may be absent and the patients life be dependent upon the recognition of the clinical symptoms. The diagnosis of scarlet fever is always important and sometimes difficult.

The rash may be slight and the clinical symptoms not clear. If the physician has made a thorough study of the class coccus in relation to this disease, he will find it of value in making a diagnosis and in protecting susceptible individuals. In this case it is environment which causes malignancy. Scarlet fever is produced only by the multiplication of the infection in the blood of a susceptible individual.

This environment cannot be produced in the laboratory. If bacteriologists will take their microscopes to the scarlet fever patient and study the germ under the conditions in which it causes disease, they will find evidence that it is the causative germ. When I have found this germ in large numbers in cultures from anginas, I have put the attending physician on his guard and the rash has been observed when it might otherwise have been overlooked. In one case of an adult, the rash was so slight that there was some question about it, but a considerable amount of albumen appeared in the urine ten days after. A congested throat may cause a soil in which the coccus may multiply and produce a severe angina.

If the blood is not susceptible, it remains a local inflammation ; if it is, scarlet fever follows. In the diagnosis of gonorrhoea, the microscope is of importance in the acute stage.

It will also show the value of different methods of treatment. Its greatest importance is in the examination of individuals who have had this disease at some remote period and who wish to know, before intended marriage, if the gonococcus is still present. In such cases the clinical symptoms may be entirely absent, but germs may remain for long periods of time in the interstices of the prostate gland, or other parts of the genital tract, in sufficient numbers to infect a female under the conditions of marital relations. By the careful examination of the discharges from these parts, the gonococcus may be found and the unhappy consequences to the future wife averted.

Microscopic evidence is far too often neglected in the diagnosis of influenza. There are saprophytic bacteria living in the human mouth which take on virulence under favorable conditions and produce severe catarrhal disturbances. These germs stand in a similar relation to influenza that the germs causing anginas do to diphtheria. If a correct diagnosis could always be made, the germ would soon assume its proper position as a disease causing factor. Influenza is contagious and should be isolated. Invalids and people of advanced years are susceptible, and it is the duty of the physician to protect them as he would children from scarlet fever. In the diagnosis of malaria, the assistance of the microscope should not be ignored, but in order to appreciate its value, the life cycle of the plasmodium, its various forms and all the conditions under which it may be found, as well as the various forms of the disease in which it is absent, must be understood. The physician should keep pace with the work of the bacteriologist in order to properly value microscopic evidence.

When the Widal test for enteric fever came out, we were amazed at the accuracy with which it confirmed the diagnosis of typhoid fever. Extended knowledge has demonstrated that it is not infallible. Allowing that in a small per cent of cases the reaction is not present, it is by far the most reliable evidence we have in typhoid diagnosis at the present time. It is to be hoped that further investigation will determine when the reaction is not reliable.

There is a tendency among those physicians who have not had a bacteriological training, to under-estimate the value of microscopical diagnosis.

Influenced by the teaching that the germ is the all sufficient cause of disease,the bacteriologists in the past have claimed too much. To them the germ was the disease. Now that the bacteriologists have had to recede from this position, the doctor who does not use the microscope, believes that it weakens all microscopical evidence. This is not true. Microscopical evidence is of more value than ever before, if the physician has the knowledge to appreciate it. The fact that we have a pseudo-typhoid, a pseudo-diphtheria and possibly a pseudo-tubercular bacillus which causes the bacteriologists to hesitate, only emphasizes the necessity of the physician being a closer student of the problem of environment; of the germ which causes virulence, and environment of the patient which causes susceptibility. In a germ disease, there is a battle between two living entities, or rather two armies of living cells. When pathogenic germs find a human organism weak enough to permit an invasion, the battle is on, each using utmost power to overcome the ther. If the human cells are slow to act and the germs, or their products, are able to overcome some vital center, death results. If they respond quickly, antitoxins, phagocytes and digestive products are poured into the blood, the invading germs are overcome, digested and excreted. The existence of the human organism and its ability to complete its life cycle, depends upon its power to maintain germ immunity. The microscope, with careful technique, at times gives results with almost mathematical accuracy, which cannot be claimed for the uncertainties of clinical diagnosis alone.

In the use of the microscope, a physician should keep in mind that most often the greatest safety of his patient, and his own best mental development, comes through the close study of the clinical phenomena of disease.*C Clinic.*

MICROSCOPICAL MANIPULATION.

Proper Angle of the Microtome Knife.—Dr. B. Rawitz (Journ. Micros.) finds from experiment that the microtome knife should be placed at an acute rather than at a right angle. When placed at the latter angle, the sections, according to their thickness, are always more or less crowded together, thus distorting the finer structures of the tissues cut.

Patches on Sycamore Leaves.—If one will examine the under side of a sycamore leaf, he will probably find a number of minute dark brown discs attached to it. These, if carefully transferred to a microscope slide and moistened with a drop of water, or perhaps better, a 50 per cent solution of liq. potassæ, will show with a ½in. or ¼in. objective,very pretty objects. They belong to the group of fungi Ascomycetes, popularly known as "Sac fungi," and these particular ones are probably Uncinulæ mecator, or an ally, others similar are found on Virginia creeper and lilac leaves. If the cover-glass be pressed a little, asci with ascospores may be forced out. Some suppose the black spots on the leaf are due to a fungus ; this may be so. I have carefully examined these spots for years, and have never been able to connect the one with the other, and shall be glad to hear more about this interesting microscopical subject.—W.H.D.M.

MICROCHEMICAL DEMONSTRATION OF THE PRESENCE OF COPPER.—For the demonstration of the presence of copper by microchemical means, according to Pozzi-Escot in the Chemische Zeitung, two compounds of copper iodide and ammonia are especially suited. An ammoniacal copper oxy-salt solution, decomposed by the addition of potassium iodide, yields a crop of minute blue tetrahedric crystals, with the formula CuI_{24}, NH_3 , H_2O. If to an ammoniacal copper oxy-salt solution, sufficient ammonia be added to dissolve the copper salt by aid of heat,and the same be heated about 40° C., under the addition of sodium or ammonium iodide, the liquid becomes yellowish green, and brown-black rhombic tablets, whose composition has not yet been established, are thrown down. The substance is probably CuI_4 NH_3 . It is very easily decomposed—disappearing fully within 10 minutes, leaving only yellowish green prismatic tablets to be seen.

NEW PUBLICATIONS.

The Microscopy of Drinking Water.—By George Chandler Whipple. New York, John Wiley & Sons. 1899. pp. 292, Plates xix.

In this work, the historical matters are given, besides a very excellent account of the object of the microscopical examination of water, and the different methods in vogue such as Sedgwick-Rafter, the Plankton net method, the Plankton pump, the Plankton krit, each of these given in sufficient detail to enable any student to make use of them. In chapter IV the writer considers the microscopic organisms in water from different sources such as rain water, ground water, surface water. The bacteria are largely omitted. There is a brief allusion to them as well as one plate describing the different types. Then the writer takes up the subject of Limnology treating the ponds and lakes, their geology, geography, physics, chemistry, biology and the relation of these to each other. The work is an excellent one and should be in the hands of one who are interested in the study of water and its organisms.—L. H. PAMMEL.

Text Book of Inorganic Chemisty, By Victor von Richter, edited by Prof. H. Klinger of the University of Kœnigsberg, and translated by Edgar F. Smith, Professor of Chemistry in the University of Pennsylvania, Philadelphia. Fifth American from the Tenth German Edition, containing 68 illustrations on wood and a colored lithographic plate of 'Spectra. 8 vo. pp. 430. Philadelphia, P. Blackiston's Son & Co., 1900. Price $1.75 net.

In presenting this subject to the student, the author has made it a point to bring out prominently the relations existing between fact and theory, which treatment will greatly aid the student in obtaining a thorough knowledge of a highly important science. Ample space has been given to the consideration of the more recent, well-established discoveries in chemical science and valuable additions have been made relating to the general properties and measurement of gases, to the atmosphere and the interesting constituents lately observed in it, to the theory of dilute solutions and electrolytic dissociation, to the electroysis of salts, to alloys, etc. This work, which reflects credit upon both author and editor, we are pleased to endorse and recommend to the profession and scientific public.

DIE MIKROSKOPISCHE ANALYSE DER DROGENPULVER.—Microscopical Analysis of Powdered Drugs—An atlas for Apothecaries, Druggists and Students of Pharmacy, by Dr. Ludwig Koch, professor of botany at the University of Heidelberg. First volume, First number. Published by the Brothers Borntraeger, Berlin, 1900. Price 3 marks 50 pfennig (85 cts.), post free.

The contents of this first volume embrace the Cortices and Ligna (barks, peelings and woods) of the German Pharmacopœia, the present issue being devoted to Cortex Aurantii Fructus, Cortex Cascarillæ, and Cortex Chinæ Succirubræ—these being preceded by a general and special introduction, in which the methods of investigation, including preparation of the sample, the media, reagents, etc., are fully set forth, as well as the special microscopical methods of research. There is also a special introductory dissertation on the Cortices of the Pharmacopœia, their anatomical structure, etc.

The work will appear in parts, from time to time, but without fixed periods of issue, until completion, each part costing 3 marks and 50 pfennigs, or say 85 cents of our money. The exact number of issues has not yet been announced. Every apothecary interested in the microscope, and every student of pharmaceutical microscopy should have this work. Nothing like it has ever been issued in any language, and that it is in German, should make but little difference, in this region, at least, where a general knowledge of German is almost universal among the educated classes. The plates alone are worth the money asked for the book.

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The Beginning of Things.

ARTHUR M. EDWARDS, M. D., F.L.S.

How things began at the first, of course we do not know, but how they begin now we can pretty thoroughly understand. And this can be told to us by those who use the microscope. I say use advisedly. For playing with it is not using it. To use it understandingly, we must work with it over and over again. We must have the most authentic and the best objectives that can be got. In fact we must be thoroughly *au fait* with its use in every branch of science. Then working with the microscope we find the following things.

We look at a mass of water, such as is recently distilled, and we see that it is transparent, that is to say we do not see anything in it more than we do when examining it not magnified, and seen with the unassisted eye. It seems to be colorless, and we look through it and see objects on the other side. But after a time while we look longer and longer at the water it becomes milky, as we say. It becomes faintly, shadowy and slightly opaque. Now what is this change due to? It becomes nebulous in fact and this nebulosity must be due to some change in the composition of the water as we know.

It cannot be the same water that we have been looking at previously. It must be something else than water which has appeared, and this can be seen by placing a mass of water in a vessel at any time, but preferably in the spring and still more preferably when something has been dissolved in it. A solution of hay is commonly used, and has been used for a long time when what is called "spontaneous generation" is looked for.

Now using a magnifying power of at least twelve hundred diameters, 1-12th of an inch objective as it is commonly called, with a No. 3 or B occular we have such a magnifying power,and we see that the nebulosity is caused by extremely fine organisms or seeming dots. They are in constant motion, not in one way, but trembling this way and that. They are what are called Monads. Monad is a term of D. F. Muller which Pritchard says in his History of Infusorial Animalcules, 1852, are so named from its having been supposed to be the limit of animal organization. First there appear masses of jelly-like extremely small amœbas. Let us see what Dr Leidy says about it for he gives the best account of amœba that I can find. He says "it is an animal" when at rest, a spherical or oval mass of soft, hyaline, colorless, homogeneous, pale, granular protoplasm, possessing extensile and contractile power, and in the active condition devoid of an investing membrane, or any kind of covering. This is all. It is in motion when we see it, but motionless when first found.

Let us imagine a drop of the white of an egg, any kind of egg, be it animal or vegetable or protiston. For that is protoplasm and is also an amœba. I speak advisably. For it is an amœba, for chemically or otherwise it cannot be distinguished from a living thing which we call an amœba. We have then seen life beginning and begun a living thing, an amœba.

Now what is the origin of this living thing, this amœba, this mass of protoplasm? From what do they or it originate? From protoplasm as botanists call it, from sarcode as zoologists term it. This is the "physical basis of life" as Huxley termed it,the origin or beginning of force or energy, the "jelly specks" of the biologist. And going no further back than these "jelly specks" can we determine their beginning? I do not see how we can, and yet we can appreciate the origin of those "jelly specks." But we must determine and appreciate their origin materialistically also.

We cannot see how they originate from unseeable, unrecognizable matter. But we can see if we watch unseeables change to seeable matter. I do not know how it is possible, but it is possible, although our eyes are not strong enough to see it. We see what is before them and still is unseeable with any power of the highest magnifying lenses which we now have. For that cannot reveal even the ultimate molecules of the physicist, and the molecules are of course unseeable. Let us begin therefore where we can see.

As I have said,when we view the mass of water which contains protoplasm in it,or if we take the white of an egg and wait until it changes, which it does in time, it putrifies, we say. It then becomes alive, Bacteria or Monads appear in it, and this it does when it is covered up out of contact with the air. It so putrifies also. Bacteria appear also, and life is formed. We cannot know how it is but we see it. We see that our water is transparent. But while we are looking at it there appears a certain darkening as it may be called, or a shadowy appearance where the water is becoming cloudy, and this is where the protoplasmic unit, as it has been called, appears.

Here the "jelly-specks" eventuate. It is hazy at first but at last there appears an amœba. This is the thing called der kleine Proteus by Rosel,in 1755, in his Insecten Belustigung. Dr. Leidy says that it is this thing which Rosel called an amœba in his Recreation Among Insects, published in Nurenberg. He accompanied his descriptions with nineteen well-executed and colored figures engraved by himself. In fact this is what the microscopist sees generally.

But I think he can see something which appears also still more generally. In short I have seen this thing for several years, about forty, everywhere where moisture, not water exclusively, is present. In the green scum that appears on trees, in or on clay, or on the soil that is in the fields or in gardens, and in fact everywhere, where organic and inorganic matter is and is moistened. I saw it over forty years ago and have waited to publish it until now. There is a granular matter, so to call it, much,smaller than the tiniest amœba that can be seen. It is called monad by Muller. We can see it when taking some clay and examining it under a microscope, by immersing it in water. A 1-12th of an inch, or a 1-16th of an inch objective if it is well made, will show it very well. A ¼th of an inch has shown it but not well. It is not exactly round or spherical.

It is somewhat oblong, nearly like an egg, a chicken's egg, only it is the same shape at both ends, whilst the egg is longer at one side than the other. Then again it is not at rest. It is in motion, trembling on in its path. Not seeming to have any part formed for a head or other function, but trembling and seeming unstable in being. It has been instanced as an example of Brownonian motion, and it is Brownonian motion.

The mode of motion of the granule has not been, it seems to me, thoroughly explained as yet. I explain it in this manner, and I will illustrate in this way. Let us drop a piece of sodium, (natrium the Germans call it, and we Latinize it by calling it natrium in chemistry and denote it by the symbol Na), into water and watch what takes place. We represent the water by the symbol H_2 O. When the Na comes into contact with the H_2 O, it immediately takes up the O and forms the compound Na O. At the same time it sets the two equivalents of hydrogen free. When O unites with Na, a chemical action is set up and heat is generated, heat enough to fuse the Na O, and when a substance is fused it becomes a liquid and when a liquid it assumes the form of a sphere which rests upon the plain surface of the H_2 O. But H_2, hydrogen, is a gas, the lightest substance known. It forms just at that point where the Na O, the sphere, rests upon the water, and tends to escape upwards, (for it cannot escape downwards) and pushes the globule of Na O to one side. As the globule of Na O has thus begun its travels it rushes to the opposite side until it rolls upwards on the surface of the plain of water until it meets the side of the containing vessel when it rolls down again.

Thus the motion has commenced. A motion which remember resides in, and is so to speak, a portion of a dead particle of matter. Now what does that motion consist of, and what is its cause ? The chemical or physical action of the molecule of this fluid,—Na in this case, acting on the molecule of the fluid, H_2 O in this case. And all motion is this chemical or physical action. I say all motion, be it in a molecule of the so-called dead matter, Na O, or a molecule of the so-called living matter, protoplasm, a monad or a man himself.

And in what can the so-called living matter be distinguished from the dead matter? Nothing but motion, and dead matter has that also. This monad has been bandied about between the animal kingdom, as usually recognized, and the vegetable kingdom by every observer. It seems they make some new discovery which entitles him to place it in one kingdom or the other,—sometimes as a whole organism, sometimes as a stage or a portion of an organism.

An amœba is found in the soil in the fall where malaria prevails in Newark, N. J., and most likely at other points. It is round or spherical and no nucleus or nucleolus is seen. It is stationary, not moving at all and may be kept two or three weeks and does not seem to change at all in all that time. It is like figure II, Plate V, in Leidy's Fresh-water Rhizopods of North America,1879, under the name of Amœba villosa, but as shown by Leidy's figures from 1 to 19 it changes its relations and appearances to a vast extent. In short it makes various appearances and shows as amœba proteus, verrucosa and radiosa, in fact others also.

We cannot distinguish by appearances one of these amœbas from another, and they cause or do not cause different relations in various animals and vegetables when they come into contact with them.

When the chyle or limph is examined, it is found to contain certain objects which are alike and, in fact, are, as far as we know, amœba. They have the appearance of amœba and these are also found in blood along with red blood corpuscles. They are known as "white" or "colorless corpuscles" or "leucocytes." They are mentioned as "amœboid in motion." In fact they are amœba and have all the qualities of an amœba, and take up food and other apparently unassimilable bodies like any other amœba. But the strangest thing about amœba, and this applies to the leucocytes likewise, is that they are present in large numbers when the individual suffers from what is called malarious fever. This is the parasite which has so world-wide a reputation as being the cause of or at least accompanied by malarial fever.

The classification of the parasite is of much uncertainty. Some observers place it in the animal kingdom and some in the vegetable kingdom, but none place it in the protista, so far as I know. Ranking it in the protista is provisional of course. It is a biological organism, having what is known as life and being moveable and going about its way reproducing and dying.

These organisms are omnipresent and omnipotent, but existing and reproducing and passing away as are all things and thus we see the beginning and the ending.

PERIFERAL NEURITIS.

ROBERT A. FLEMMING, M. D.

Proceedings of the Scottish Micro. Society, Vol. III.

These words used to denote a certain change of condition of the nerves, have recently been prominent in the papers in connection with the subject "arsenic in beer."

In a paper on ascending degeneration and the changes which occur in the central end of a divided nerve as the result of section or ligature, and I described the changes consequent thereon in the nerve-cells of the anterior cornua of the cord, and the cells in the ganglia in the posterior nerve-roots. Similar changes occur in these nerve-cells in peripheral neuritis, the cells show marked chromiatolysis, peripheral displacement of the nucleus, and diminution in size of both cell and nucleus. Not infrequently the chromatic granules are gathered in a dense mass around the nucleus, while more rarely they become peripherally arranged.

But it is especially the changes in the nerves themselves which I wish to demonstrate. These changes consist in:—(1) Degeneration of nerve fibres, axis cylinders, and myelin sheaths. (2) Changes in the blood-vessels, especially the capillaries and arterioles of the nerve. (3) Exudations into the funiculi of the affected nerve.

(1) *Degeneration of nerve-fibers, axis cylinders, and myelin sheaths.*—The axis cylinders become vacuolated, soon break up, and, as described by Von Bunger and others, many fragments of axis cylinder may be seen enclosed in myelin balls inside the neurilemma sheath. The myelin breaks up into smaller and smaller balls and eventually disappears. These changes are better marked near the periphery of the affected nerves; but they do not gradually become more advanced the further the nerve is traced from it origin. Healthier portions of a nerve fiber may be seen between more degenerated parts, and careful study of many sections cut from a single nerve, such as the anterior tibial, demonstrates one remarkable point to which far too little attention has been directed, namely, that the segmental nuclei—i.e., the nuclei of the neurilemma sheath, have a very important trophic influence over the axis cylinder which it protects; it has been fairly definitely demonstrated that these segmental nuclei proliferate rapidly once the axis cylinder and myelin sheath have degenerated; but it is important to note that in these intervening more healthy parts of a nerve fibre, the integrity of the segmental nucleus and the integrity of the axis cylinder occur together.

It has even been suggested that the new axis cylinders may develope from segmental nuclei in the processes of regeneration of a nerve fibre. But, although this is contrary to my experience, and from an embryonic standpoint is most improbable, such statements show that to these segmental nuclei more important functions are described than formerly, and indirectly they strengthen the position which I take up.

The disintegration of the myelin sheaths requires no special description, as it is exactly similar to the degenerative changes which occur in a nerve fibre undergoing degeneration after section from its trophic cell.

I wish, however, to draw your attention to the fine medullated fibres which are contained in all sensory-motor nerves, and to the fact that they appear to degenerate specially early and completely in peripheral neuritis. These fine fibers are of extremely small size ; they have a distinct, although comparatively slender, myelin sheath, and they generally occur in small groups throughout each funiculus. These fibers have often been mistaken for non-medullated nerve fibers when the myelin sheaths have not taken on the staining reagent sufficently deeply. In a paper published in the *Journal of Anatomy and Physiology*, I ventured to assert that these fibers were mainly vaso-motor in function, an opinion held also by Gaskell, and were more intimately associated with the changes in the blood-vessels, and the exudations which occur in peripheral neuritis. These fibers are especially well supported by connective tissue strands, and when they degenerate they are replaced by fairly dense fibrous tissue which marks their former site. This I can show you from sections taken from the central end of a rabbit's sciatic nerve, some six weeks after division or ligature, special care having been taken to prevent reunion occurring.

Just above the section or ligature, the sites of these fine fibres are marked by small dense areas of connective tissue. This is due, I believe, to the rapid degeneration of these nerve fibers when their function is interfered with, the vessels which they supply being in the peripheral part of the limb. A little higher up these small strands of fibrous tissue still contain a few healthy minute nerve fibers, and the number increases as the nerve is followed upwards to the cord.

The association between these fibers and the vessels can be traced in the following way :—The fibrous tissue replacing the fine fibers contracts, and where most of the fine fibers have lost their function—near the divided end of the nerve— any fine fibers in the immediate neighborhood, whose function is still intact, cannot escape pressure. The vessels in the lower part of the central cord of a divided nerve show the nuclear proliferation, and, to a certain extent, the perivascular exudation to which I refer later.

These changes become less marked as the nerve is followed upwards towards the cord, and therefore it seems probable that the effect of pressure on these fine fibers is to produce changes in the vessels which are very similar to those met with in peripheral neuritis.

It should be added that unquestionably these fine fibers, if vaso-motor as I contend, supply vessels in muscles and other tissues as well as in the nerves themselves, and similar changes may be seen in the walls of the vessels supplying the muscles, etc., as in the vessels of the nerves.

In peripheral neuritis, the first fibers to suffer degenerative changes are these fine fibers, and where they suffer, exudations and vascular changes follow. There is hardly any question, in modern neurological opinion,that the toxin in alcoholic neuritis affects the cell, the centre of the neuron first, and probably chiefly, while the nerve fiber is secondarily affected. We know that the cells in the anterior cornua of the cord, the cells in the posterior nerve root ganglia, and even the cells in the brain undergo distinctive changes which are often selective as regards group or groups of cells affected in different cases.

It is much more difficult to describe the changes which always certainly occur in the vaso-motor cell centres. My efforts to elucidate these changes have so far been very contradictory. It seems not improbable that the toxin has selective action on parts of vaso-motor neurons ; and as I hope to be able to show, the pathological changes in peripheral neuritis strongly support this opinion.

When the affected nerves from a case of peripheral neuritis are examined, the small fibres are seen to be specially degenerated, and, in common with the other nerve fibres, more and less affected parts of the nerve occur irregularly, often a less affected part being peripherally situated to a part much more markedly degenerated. This fact has been stated by many observers, and examination of nerves by serial or nearly serial sections demonstrates the truth of this statement.

The explanation may, I think, be sought in the second and third divisions of this paper to which I now refer briefly.

(2) *The Changes in the Blood-vessels.*—These are: proliferation with enlargement of nuclei of the endothelial cells of the intima, as also nuclear proliferation in the media and adventitia in the smaller arteries and capillaries, and to a much less extent in the smaller veins.

The nuclei of the intima almost block the lumen of the smaller capillaries and all the smaller vessels in the nerve, and those in the muscles are similarly affected. These changes are well marked in peripheral neuritis, and are also found near the end of the central portion of a divided nerve, but are not nearly so definite in the peripheral end of a divided nerve.

(3) *Exudations into the Funiculi,&c.*—These are typical of toxic neuritis. They are well seen round the vessels, and especially those showing the nuclear changes. These exudations may also be seen round the blood-vessels of the peri- and epi-neurium and also the muscles.

The nature of the exudation varies:—It is generally apparently lymph with a varying number of leucocytes and lymphoid cells and sometimes red blood-corpuscles.

The amount of the exudation varies greatly in different cases, and when they have been in existence for some time, young connective tissue cells may be seen replacing the exudation, and of necessity resulting in incomplete recovery of function of the nerves so affected. Exudations almost certainly point to an inflammatory process as distinct from simple degeneration. They are absent in the peripheral end of divided nerves, but a limited amount of exudation is seen in the central end of a divided nerve.

I believe the exudations in peripheral neuritis are due to the local action of the toxin either in lymphatics or blood-vessels or both, and the varying amount of exudation at different levels in an affected nerve may depend on the fact that the blood supply to the funiculi enters by small branches of arteries, which run for a long course down the funiculi; and probably, where the branch enters the funiculus there the exudation is most marked. My serial sections so far bear out this theory, although it is difficult to prove that it is absolutely correct.

Of more practical importance is the *role* played by the exudation in causing the pain, interference with function of nerve fibres, and when not removed, the permanent disablement of the nerve.

The affection of the fine fibers, the nuclear proliferation in the small arteries and in the capillaries, and the exudations are apparently all closely related together, and I have endeavored to demonstrate how far the connecting links in my chain of evidence cover existing facts, although I admit much has yet to be discovered before the theories can be considered indisputable.—*English Mechanic.*

Is the Bacillus Always Present in Pulmonary Tuberculosis?

HUBBARD WINSLOW MITCHELL, M. D.

The presence of the tubercle bacillus is generally regarded as an infallible sign that the disease is true tuberculosis, and I have myself hitherto regarded this sign as infallible, but in many cases which have come under my care where the symptoms were of unusual severity, such as coarse bubbling rales, more or less extensive in one or both lungs, extreme emaciation, night-sweats, diarrhœa, loss of appetite, thirst and fever, with copious expectorations of offensive sputum, no bacilli existed. Some of these cases recovered, while others died.

The microscopist who examined the sputum several times in each of these cases pronounced them not tuberculous because he found no bacilli, yet the symptoms differed in no single respect from the cases where bacilli did exist, and were associated with a similar train of symptoms. If these were not tuberculosis, they certainly were not to be distinguished from it, and I treated them in the same way as I treated the cases where bacilli were persistently found.

If the presence of the bacillus is the absolute and unvarying sign that the disease is tuberculosis, and that cases without the bacillus are not, then our task is easy. But what shall we say when two cases present themselves, each having all the severe and distressing symptoms that accompany pulmonary tuberculosis, and in one case there are bacilli, and in the other there are none, yet each running a course identical in all respects. I have seen numerous cases where no bacilli were found at any time during the course of the disease, yet they were just as severe, and quite as fatal as cases where bacilli were persistently found.

The number of bacilli in a case, whether few or numerous, seems to have no special influence upon the severity or duration of the case. Cases where few or many bacilli, or no bacilli at all were found, were not to be distinguished from each other. If then, cases are identical where bacilli do exist, with those where they do not exist, then we must look a little further before we say positively that pulmonary tuberculosis depends for its being upon this special germ.

In all cases however, the pus-cell is present. Whether or not we find the bacillus, the pus-cell is never absent. The ulcerative nature of the disease would tell us this. Now this ulcerative condition of the lung we call tuberculosis, seems capable of generating a certain toxic principle, which poison enters the lung of some other individual and sets up a like process there. It seems not unlikely that the pus-cell may be freighted with this special subtile poison, and when voided in the form of sputum and dried, it may commingle with the surrounding dust and find its way to a healthy lung and set up its baleful influence. We are taught that the disease is disseminated solely by the bacillus, but in view of the above facts, it would be well to watch and study the influence of the always present pus-cell.

In beginning treatment in a case where a reasonable hope appears for a final cure, the first thing in my judgment to do is to improve the physical condition of the patient by the use of nutritious diet, by rest, the free use of the bath, by quinine and strychnine to reduce fever, by the judicious use of stimulants such as whiskey or brandy, to fill the depleted blood vessels by the copious use of some good mineral water, and lastly and above all, the persistent use of some remedy which is calculated to saturate the blood and so bring it in contact, as far as possible, with the diseased portion of the lung.

In my hands the use of the solution of hypochlorite of sodium to which is added hydrochloric acid and bromine has proved the most efficient.

I usually give the remedy in half ounce doses before each meal, and at bed time, and sometimes I have increased it up to 3 and 4 per day, but rarely above 3. It must by perservered in for a long time as the disease is very chronic in its course, and with the adjuncts above named, with complete rest I have had results which greatly encouraged me.—*Medico-Legal.*

Do Bacilli Kill?

SURGEON GENERAL WALTER WYMAN.

Many people live a long and active life with tubercle bacilli encysted in the apex of one lung. As long as they have plenty of fresh air and sunshine, and good sanitary surroundings, they remain well. But give such a person poor food or bad sanitary surroundings and see what happens. The battle going on between the bacilli and the cells results in a victory for the bacilli. The cells die and the victorious bacilli spread havoc through the lungs. We, therefore, have a scientific proof of the sense of the old-time notions of the old-fashioned doctors, who taught the value of fresh air and sunshine, of good food and exercise, of cleanliness and dry dwellings, and we find that the conditions of health which result from such good sanitary conditions are, after all, among the very best preventives against infection.

That good sanitary environment, enhancing the general health, is the best means of eliminating contagious disease, is illustrated by a conversation which I have had within a week with the Director of the Hygienic Laboratory of the Marine Hospital Service, Dr. Rosenau, who has just returned, after a prolonged period of study and investigation in the Pasteur Institute in Paris. Upon inquiring as to the latest phases of scientific investigation and the trend of thought at this great intellectual centre, among other matters, he stated that there seems to have arrived a period of pause in bacteriology, or at least a spirit of inquiry as to the true relation of microbes to the diseases of which they have been considered the special agents. Dr. Rosenau's statement is as follows:

"We have lately been compelled to modify some of our notions of the causes of contagious and infectious diseases. After the brilliant discoveries by Pasteur and Koch, it was thought that the presence of the pathogenic microbe organism was like the bite of a venomous snake, surely poisonous. But now we know that there are other conditions beside the presence of the microbe necessary to produce disease. Many people go about with virulent cholera vibrio in their intestinal canal, yet they are not sick, have pneumonia. Why? Because their cells are vigorous enough to prevent the diplococci invading the lungs, but put such a person under bad sanitary conditions, or depress his vitality, and the microbes are not phagocyted—they invade the lungs and pneumonia and death follow."—*Address at Havana, Feb.* 7, 1901.

Malaria.

LORD LISTER.

Before the Royal Society.

The subject has now reached a stage at which it may be not unfitting to refer briefly to what has been accomplished. The term "malaria" implied the belief that some vitiated state of the atmosphere was the cause of the disease. But the knowledge gained of late years of the parasitic nature of infective disorders pointed clearly to such an origin of the intermittent fevers, as the various manifestations of malaria have been termed. Accordingly diligent and long-continued search was made in the water and the soil of malarious districts in Italy for the suspected living agent, but without success. The discovery was made in 1880 by Laveran, a French army surgeon stationed in Algiers, who observed in the red blood corpuscles of malarious patients what he regarded as adventitious living organisms ; not of vegetable nature like the bacteria which constitute the *materies morbi* of so many infective diseases, but a very low form of animal life. In what he believed to be the youngest condition of the organisms, they appeared in the red blood-discs as tiny specks of colorless protoplasms, possessing amœboid movements. These growing at the expense of the red corpuscles which they inhabited, consumed them more or less completely, at the same time depositing in their own substance a peculiar form of dark brown or black pigment, such as had long been known to form characteristic deposits in the organs of malarious subjects. As they grew they assumed various forms, among which was what Laveran termed the "rosace," a rounded body bearing at its circumference little spherules, while the pigment was accumulated at the centre. This discovery of Laveran's, at first regarded with the gravest suspicion by pathologists, was the first great step in the etiology of malaria. It supplied the means of distinguishing the disease from its counterfeits, and it explained the wonderful specific efficacy of quinine, till then given only empirically. Quinine is remarkable in the circumstance that it acts with deadly effect upon some microbes, in dilutions which are quite unirritating to the human tissues. It can thus be given in sufficient doses to kill the malaria parasite in the blood without injuring the patient. Nine years after Laveran's discovery, Golgi, of Pavia, who had been specially studying the "rosace" form of the parasite, and who had become convinced that the spherules at the circumference of the rosace were sporules of the microbe, announced that he had observed differences between the rosaces of tertain and quartian forms of fever, so great and so constant as to make him satisfied that they were two distinct species of organism. At the same time, he had made the extremely important observation that the periods of occurrence of the fever corresponded with the times of maturation of the rosaces. These all coming to maturity about the same time, shed their sporules into the blood, and this determined the febrile attack. The free sporules, then, according to his view, attached themselves severally to other red discs constituting Laveran's tiny amœbæ, and grew in the red corpuscles without causing symptoms till they had produced a fresh crop of sporules ripe for extrusion; the time for this being two days in the tertian and three days in the quartian form. Thus the periodicity of the intermittent fevers and their variety in that respect were alike explained. A few months later a third species of the parasite was recognized, having the peculiarity that some of its individuals, instead of being of rounded form were of crescentric shape. These species received the title æstivo-autumnal, on account of the season in which it showed itself in Italy. It was not so regular in its periods as the others, and was much more dangerous. The existence of these different species was at first very generally doubted, but it is now universally accepted, and is of very great importance. The examination of a drop of blood from the finger of the patient enables the physician to decide not only whether the disease is malaria, but which of the three types it will follow. The more dangerous crescent form is commonest in the Tropics, and hence has been termed by Koch tropical malaria. The quartian has proved the mildest of the three. The process of sporulation might seem at first sight to explain the whole life-history of the parasites. For their propagation within the human body that process does indeed make ample provision. But the mystery remained—how did they gain entrance into the human system? Though present in abundance in the blood of the malarial patient, they are absent from the excreta. Spontaneous generation having been long since exploded, what could be their mode of origin in the external world? This problem has of late been completely solved. Among the forms of the parasite observed by Laveran was one which he termed "flagellated," possessing filamentous appendages which exhibit extremely active movements, by virtue of which they were often seen to break off from the parent microbe and swim away. These flagella were regarded by many biologists as products of degeneration resulting from the abnormal influences to which the parasites were exposed in blood outside the body. This Laveran could not believe; indeed, it was the remarkable activity of the flagella that finally satisfied his own mind that what he had discovered were really living parasites; he regarded the flagella as the highest form of development of the microbe. There was another observer who felt equally convinced that the flagella were living elements—our Fellow, Dr. Manson. He, however, went a step further. Seeing that the flagella were never met with in blood when first drawn, but only made their appearance after some little time had elapsed, he conceived that their function must be that of spores for spreading the parasite in the external world, and some suctorial insect seemed to him the probable agency for their diffusion. He had observed several years ago that another parasite of the human blood, a microscopic nematode worm, Filaria, is drawn with the blood into the stomach of a kind of mosquito, and finds in the insect a secondary host, in the tissues of which it passes through a new cycle of development. He became deeply impressed with the idea that a similar series of events might occur with malaria, and he expounded his views fully before the College of Physicians. The notion that mosquitoes might be in some way associated with malaria had occurred to Laveran and to others, but by no one had it been brought home with such logical force as by Manson.

MICROSCOPICAL APPARATUS.

APPARATUS FOR THOROUGH STERILIZATION OF MILK. I. JUNDELL.—That tubercle bacilli are not killed by the usual methods of sterilizing milk in creameries has been demonstrated by the discovery of living bacilli in market butter made according to the most approved modern methods. Jundell ascribes this failure in thorough sterilization to the fact that the bacilli are not exposed long enough to the high temperature required to destroy them all. He has invented a contrivance to supplement the ordinary apparatus, which, by retarding the circulation of the milk through it, enables the action of the heat to be prolonged and accomplishes the desired end without injury to the milk. It consists of a cylinder fitted with a number of alternating horizontal discs nearly filling the lumen. The milk thus follows a zigzag course through it. Tests with animals inoculated with milk infected with enormous quantities of bacilli and then sterilized in this manner, showed that not one of the bacilli had remained alive. Jundell uses it with the "G. Salenius radistor," which enables the butter to be made at once from the cream without further delay or manipulation.—*Nordiskt Mediciniskt Arkiv* (Stockholm), August 9.

USE OF THE MILK THERMOPHORE.—Dr. Paul Sommerfeld says that milk kept in a thermophore for five hours is as free from bacteria as sterilized milk. Tubercle and typhoid bacilli are rendered innocuous by this time. Previously sterilized milk placed in the thermophore is rendered absolutely free from germs in five hours.—*Berliner Klinische Wochenschift*, Oct. 1, 1900.

MICROSCOPICAL MANIPULATION.

CANADA BALSAM AND PINE TURPENTINE COMPARED.—From an investigation carried out by Tischtschenko (*Chem. Zeit.*) it seems that the turpentines of the fir and of the pine are very nearly identical in composition and properties—that the products of both substances have identical proprieties and qualities, and that the resins are in all respects the same, even to the indices of polarization. The investigator, therefore, concludes that pine resin may be substituted for Canada balsam in all cases.

This statement may be, and probably is, true of the turpentines of European pines (*Pinus larica, P. silvestris, P. pinaster, etc.,*) but we scarcely believe it to be true of the produce of the Southern long-leafed pine (*Pinus australis*). At any rate, some mounts made with virgin turpentine of the long-leafed pine, treated in all respects as the Canada balsam in preparing it for a microscopical mounting medium, soon spoiled, becoming granular and opaque. It is possible, however, that the failure was due to errors in manipulation. We hope that some of our Southern readers, interested in microscopy, will experiment in this direction and let us hear from them on the subject.

A DIFFERENTIAL STAIN FOR BACILLI.—M. Gautrelet, searching for some method to stain the bacilli of tubercle so that the living microbes could be distinguished from the dead, and noting that in the urine of those suffering with hectic fever (tuberculous) the bacilli were so strongly colored by some urinary pigment that they could easily be seen and recognized, concluded that the coloration was due to urobilin. He thereupon experimented with the agent, and succeeded in staining the bacilli of sputum with it without the application of heat. He used the following formula:

Urobilin........................	1 part.
Glycerin........................	20 parts.
Distilled water..................	20 parts.
Alcohol.........................	30 parts.

To use: Spread the sputum on a cover-glass in the usual way, and place the latter, without drying or passing through the flame, directly into the solution. At the end of an hour it may be removed, the superfluous liquid taken up by means of bibulous paper, and the clean side of the cover-glass wiped dry. The object is now ready for examination. The living bacilli will be found stained a yellowish brown, and may be seen to continue their oscillatory movements. By means of examinations made by the aid of this process, M. Gautrelet was able to demonstrate that hydro-fluoric acid is a powerful anti-bacillary, capable of sterilizing tubercular cultures.—*National Druggist.*

MICROCHEMICAL REAGENT FOR TANNIN.—Lantz (*Pharmaceutische Rundschau*) states that ammonical copper sulphate is an excellent microchemical reagent for tannin. It is, he declares, far more delicate than any reagent hitherto proposed in this direction. In investigating plant-tissues for tannin, the substance is put in a test tube or watch glass and the reagent poured over it until it is completely covered, and in this condition it is set aside for from 3 to 4 hours. At the end of this time the reagent is poured off and the material is thoroughly washed with water. It can now be placed under the microscope, and the cells containing tannin will be found to be stained from brown to black, according to the amount of tannin present. The reagent is prepared as follows: Dissolve 2 gms. copper sulphate in distilled water, and add ammonia water until the precipitate at first formed is again taken up. Distilled water is then added until the solution measures 100 ccm.—*National Druggist.*

ADVANTAGES AND LIMITATIONS OF STERILIZING AND PASTEURIZING MILK.—Dr. A. D. Blackader of Montreal. Milk obtained under unfavorable conditions and kept at a rather high temperature contained many bacteria, and in addition their spores and toxins. According to our present knowledge, all forms of bacteria are undesirable in an infant's food. It had been shown that 99.8 per cent of the bacteria could be destroyed by pasteurization. The older the milk was the more difficult it was to pasteurize it. Pasteurization at 70° C. destroyed the vast majority of the forms liable to produce extensive and rapid change in the quality of the milk. It was necessary in most instances to maintain the pasteurized milk at a low temperature in order to preserve it from further change. However, the same could be said of milk heated to 100° C. Milk exposed to 60° C. or 140° F. had ninety-six to ninety-nine per cent of its bacteria destroyed. Russell had found that when milk was heated in tubes to 140° F. tubercle bacilli were not entirely killed because the little pellicle which formed on the surface of the milk protected the bacilli to some extent. If this pellicle was broken up, complete destruction of the tubercle bacilli was assured. Milk raised to 100° C. was markedly altered in taste, smell, and chemical composition. The albumin and globulin were coagulated, the lecithin and nuclein were destroyed, and the organic phosphates converted to some extent into the inorganic phosphates. For the coagulation of milk in the stomach calcium must be present in a more or less free form. It was probable that the preliminary curdling of milk was an aid to digestion. It was also probable that in milk heated in this way certain useful ferments were destroyed. As long as milk could be rendered practically sterile at comparatively low temperatures it seemed useless and even deleterious to subject the milk to a higher temperature. It was generally stated that milk was pasteurized at 157° F.—Meeting N. Y. Accademy of Medicine.

CONCERNING THE METHODS OF STAINING FAT.—By Dr. J. B. Levinson.—This author found that in staining nerve fibres by Wolter's method, droplets of fat resisted the action of decolorizing agents, and assumed a deep blue color. This, with the fact that osmic acid and Sudan III are not satisfactory methods of staining fat, induced him to study Wolter's stain with reference to its action on adipose tissue and fat droplets. After a series of experiments, he found that the following method gives a satisfactory stain for fat: (1) Fixation in Muller's fluid for from two to five weeks, depending upon the size of the specimen. Dehydration in alcohol, beginning with seventy per cent. Imbedding in celloidin. (2) Sections about 10 to 15 micron in thickness are transferred directly from alcohol into dye, where they remain for twelve hours at the 40° C. The staining solution used is the same as that recommended by Wolter, namely, a twenty-seven-per-cent solution of hematoxylin, according to Koultchitzy (2 grammes of hematoxylin are dissolved in a little absolute alcohol and mixed with 100 c.c. of two-per-cent acetic acid.) At first this dye is yellow in color, but if allowed to stand it will turn red, and its staining power will increase. (3) Washing in water. (4) One-per-cent aqueous solution of potassium permanganate, for from ten to fifteen minutes. (5) Washing in water. (6) Two-per-cent solution of oxalic acid. The drops of fat stain a grayish violet, the surrounding portions of tissue being completely decolorized. If this is not the case, the decolorization may be repeated after a trial section has been examined under the microscope. If it is desired to counter-stain the tissues, strong solutions of carmin for twenty-four hours will give good results.—*Vratch*, Sept. 23, 1900.

THE PRESERVATION OF DESMIDS.—The late Mr. W. H. Walmsley's plan was as follows: Having been perfectly successful in preserving the color in many of our fresh-water algæ, it may be that the same method would prove successful with desmids. My plan is simply to have a wide-mouthed bottle, with glass stopper, filled with distilled water, in which I have a number of pieces of camphor. When it is desired to mount the algæ,I place a portion of the same in some of this camphorated water to which a few drops of glycerin have been added, in a watch-glass. At first it will become lemon yellow, but after a few hours the original green returns in its full vividness, then I mount in a shallow cell with a portion of fluid.

MICROSCOPICAL NOTES.

Pathogenic Bacteria. An extended reprint of Dr. Dobson's article on Bacteriology in our January number is to be found in the English Mechanic and World of Science, of April 12. The article was a review of McFarland's Pathogenic Bacteria. The publishers W. B. Saunders & Co., have a London branch at 161 Strand W. C. where the work can be purchased.

DIATOMS.—Maurice Peragallo of Clermont near Paris, is issuing a "General Catalogue of Diatoms," printed by a sort of hectograph process in 16-page installments. Price 25 cents each. Up to March 1st, 30 installments had appeared and included the genera from A to K inclusive. It is in the French language.

BUBONIC PLAGUE.—The plague is now present in this country, in California. Had the State Board of Health of California had five thousand dollars at the beginning of the outbreak, probably it might then have stamped the fearful disease out of California ; but the means and public support were not provided, and the disease has continued ; now the legislature has appropriated one hundred thousand dollars with which the State Board of Health is to try to restrict the plague.

BROWNIAN MOVEMENT.—In his article upon "The Beginnings of Things,'' Dr. Edwards has given us a new philosophy of this movement. We call attention thereto so that no one will overlook it. He shows, likewise, that there is no such thing as dead matter.

BIOLOGICAL NOTES.

THE MULTIPLICATION OF BACTERIA.—A single bacterium has been calculated by Th. Nageli to weigh one ten thousand millionth of a milligram. The length of a generation is from fifteen to forty minutes. Supposing all the conditions for multiplication to be favorable the results are appalling. Cohn has estimated that a single germ can produce, by simple fission, two of its kind in an hour ; in the second hour these would have multiplied to four ; and in three days they would form a mass of four thousand seven hundred and seventy-two billions,an enormous mass, whose weight would amount to seventy-five hundred tons. Fortunately, these ideal conditions never exist, each germ requires food, and as the supply is always limited (not to speak of other items), great numbers starve.

MICROSCOPICAL SOCIETIES.

Royal Microscopical Society.—At a meeting on Oct. 17, the President, referring to the donation of Prof. Percival's work, "Agricultural Botany," said he could speak to the book being original both as to text and drawings, which was noteworthy in these days. It was an extremely valuable contribution to the subject of agricultural botany. Dr. Hebb brought before the notice of the meeting samples of stains for microscopic specimens prepared by Messrs Burroughs, Wellcome, and Co. The stains were in solid form, each "soloid," as they are termed, containing a definite amount of the reagent. The advantages of this form of preparation are simplicity and economy.

Messrs R. and J. Beck exhibited a new pattern student's microscope. It was of the continental form, and was chiefly noticeable for its cheapness, which was attained without sacrifice of quality by adopting an improved method of manufacture. It was called the "London" microscope, and had rack-and-pinion coarse adjustment, perfect micrometer-screw fine adjustment, vulcanite top stage iris diaphragm in sliding tube, and spiral substage fitting, Mr. F. W. Watson Baker gave an exhibition of slides and models illustrating the structure and development of the skin. Mr. Vezey said the society was greatly indebted to Mr. Watson Baker for giving this very excellent exhibition at comparatively short notice. Mr. Karop said he had only been able to glance at a few of the specimens exhibited, and he regretted there was no one present to discuss the subject, because several new points had recently been recognized by histologists in the structure of the skin, and it was rather a pity that the opportunity should be lost of having these demonstrated by someone who had made a study of this important and complicated tissue system. Mr. Vezey reported the death of a very well-known Fellow, Mr. Richard Smith, since the last meeting. He had devoted his attention to a study of diatoms, and was continually devising new contrivances. He had also done some good work in photomicrography. He had likewise made useful researches in the germination of wheat, and had made a large number of observations and experiments in connection with this subject, and published a book upon it. He would probably be best known to some as the inventor and patentee of Hovis flour.

QUEKETT MICROSCOPICAL CLUB.—The 381st meeting was held on Friday, November, 16. A paper on the "Resolution of Amphipleura Pellucida with Dry Lenses," by Mr. A. A. E. Merlin, was read, in the author's absence, by Dr. E. J. Spitta. Mr. Merlin claimed to have resolved this diatom, mounted in various media, with a Zeiss 4mm. apochromat, N.A. ·95, combined with eyepiece x 27, and a large axial cone; illuminant a ½ in. wick paraffin lamp and copper acetate light filter. Dr. Spitta gave an exposition of Abbe's theory, and from it concluded that either the Amphipleura used was a coarse-lined one, or that Mr. Merlin possessed a phenomenally good or "photographic" eye. Mr. Nelson said that his own sight, which was formerly very good, was now insufficient to grasp very minute intervals of separation, and, using the same optical means as Mr. Merlin, he had roughly attempted the observations given in the paper, but found it impossible with a ½ in. paraffin flame. He thought, however, that with a heliostat it could be done, and he hoped to experiment later on. He knew that Mr. Merlin had extremely keen vision. Mr. J. M. Offord said he could corroborate this; at the telescope he found Mr. Merlin could see details at once, which he himself could only discover by continued observation. Mr. Rousselet read a paper on Asplanchna intermedia, and showed by description and drawings of the mastax, how it differed from Asph. brightwelli, with which it was generally confounded. Mr. Western quite agreed with Mr. Rousselet's conclusions, and considered he had given a very valuable study of this and the allied forms.

ROYAL MICROSCOPICAL SOCIETY.—Dec. 21, 1900, Mr. C. T.

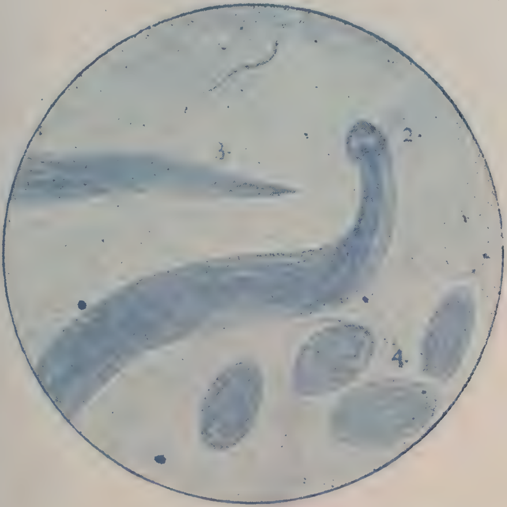
Hudson was submitted for election as an Honorary Fellow. A valuable microscope, by Powell and Lealand, with a complete set of objectives and apparatus, received from Miss Whittall, whose late father desired that it should be given to the Society, was placed upon the table for inspection. Mr. E. H. Nelson exhibited a small pocket microscope, lent for exhibition by Mr. H. E. Freeman. It was made by H. Gilbertson, of London, but the date was unknown. It is non-achromatic, and designed for field use ; it has neither stand nor stage ; but in place of the latter it has a compressorium or live-box, which slides over the body of the microscope, this sliding tube constituting its sole focussing arrangement. Dr. Webb read the list of those who had been nominated by the council for election at the annual meeting in January as officers and council for the ensuing year as follows:—as President, Mr. Wm. Carruthers ; as vice-presidents, Dr. Draithwaite, Messrs. Michell, Nelson, and the Right Hon. Sir Ford North ; as treasurer, Mr. J. J. Vezey ; as secretaries, Mr. Dallinger and Dr. Webb ; as council, Messrs. Allen, Beck, Bennett, Browne, Rev. E. Carr, Messrs. Dodswell, Disney, Karop, Plimmer, Powell, Professor Urban Pritchard, and Mr. Rousselet ; as curator, Mr. Rousselet. Mr. Barton exhibited some new forms of lanterns, which could be used for ordinary projection purposes, either with or without the microscope. The first was a lantern constructed so as to exclude all light from the room, except what passed through the lenses ; the manner of using this in connection with a microscope was shown. One lantern exhibited was larger and more complete, and could be used for all purposes, including enlargements. The excellent definition of this lantern was demonstrated by the exhibition on the screen of photo-micrographs of mounted preparations of insects and of parts of insects mounted in balsam. Mr. Barton also exhibited and described several new forms of microscope, with attachable circular stage, etc., and a new form of electric arc lamp for lantern use. A new form of lime-light was also exhibited, which attracted much notice from its extreme brilliancy, and the great steadiness and silence with which it burned. Mr. Nelson said he was very much struck with the perfection to which the last-mentioned lamp had been brought, and inquired if the gases had been enriched in any way, and how the light was produced with such a complete absence of noise. Mr. Barton said nothing was used but the two gases, and the effect was produced by causing them to impinge upon each other previous to their entrance to the mixing-chamber, and by the construction of the chamber itself.

NEW PUBLICATIONS.

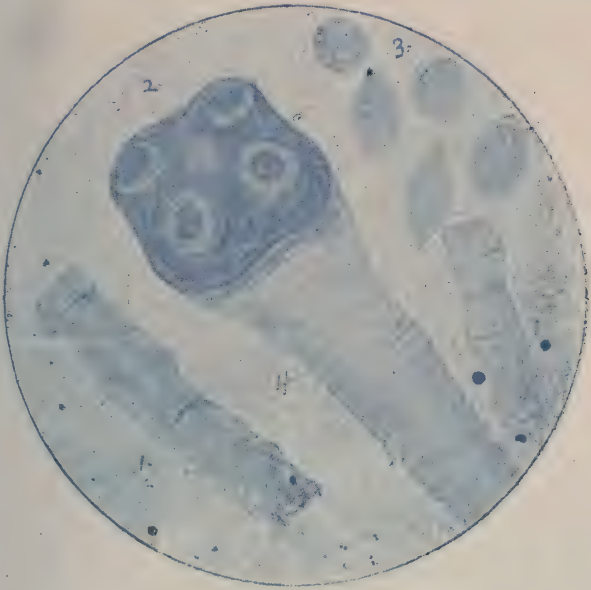
Botany, an Elementary Text Book for Schools. By L. H. Bailey. New York. The McMillan Company. vii 355. 500 f. Prof. Bailey's large experience as a maker of good text books is well known. Not only is the subject of botany treated in a clear and lucid style, but the subject matter is well arranged as a whole. In this book Professor Bailey starts out with the idea that in secondary schools botany should be taught for the purpose of bringing the pupil closer to the things with which he lives. The study of botany should begin with familiar plant forms and phenomena. Schools and Colleges should seek to inculcate a love of plants. The mere learning of names of plants should not be the ultimate end of teaching botany any more than to study one phase of morphology, but rather botany should aim to teach the plant as a whole and as a living organism. Professor Bailey has attempted to do this, and in the reviewer's opinion has succeeded admirably. Take chapter VII where the subject of buds is treated. Here we have a short definition, and a few types are given. The dormant winter bud to the flower in its successive stages are described and figured. Professor Bailey is particularly happy in his choice of subjects as well as the illustrations accompanying this as well as many other chapters in the book. Take the subject of plants in sunlight, the illustration of the fern with sufficient and insufficient light, and the branches of cedar reaching for the light, the day and night positions of the clover leaf. Take the chapter on the dispersal of seeds. Not only does the author give an excellent series of illustrations as in figures 276, 280 and 281, but the important points in the chapter are emphasized by using different type. It is certainly an excellent idea to emphasize the important points. The less important matters are easily separated from the more important. Ecology as a special topic does not receive as much attention in one place as in some other recent text books since the subject is more or less brought into prominence in nearly every chapter in part I, so there is no need of bringing the matter together in one place. The average high school is not sufficiently well equipped to take up the subject of histology, but the discussion here is ample for most schools. Part IV is devoted to systematic botany. Part II the plant in its environment should have preceded the studies in cryptogams. The subject of Cryptogams perhaps could more logically have been placed in part IV. The text is not only a credit to the author but to the publishers as well. No pains have been spared by the publishers to make it an attractive book in every way.—L. H. PAMMEL.

1,000 *Objects for the Microscope*, M. C. Cooke, LL. D. The new Edition contains 500 illustrations and much valuable matter. Price, $1.00.

Naturalist's Monthly Review is published by J. & W. Davis, Hythe st., Dartford, Kent, England. No 1 contains matters relative to insects, especially the Lepidoptera.



1.— PARASITE OF BRICKMAKER'S DISEASE.



2.— TAPEWORM PARASITE.

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Technique For the Recognition of Certain Animal Parasites In Man.

L. NAPOLEON BOSTON, M. D.

ANCHYLOSTOMA DUODENALE.—The condition produced by this parasite, when present in the intestinal canal of man, is known as brickmakers' disease, or tropical anæmia. Ova of this parasite are found in the feces of infected persons, and their detection is readily accomplished in the following manner: To a small portion of a recently voided stool, sufficient water is added to produce a cloudy liquid, when the stool and water are thoroughly mixed. A portion of the mixture is placed into a test tube and either centrifugated, or allowed to stand for a few hours. A portion of the sediment thus collected at the bottom of the tube is lifted by means of a pipette, and a drop of it placed on the center of a slide, when it is covered by a second slide or a coverglass. The specimen is now ready for examination and should be studied under a $\frac{2}{3}$ lens, where the ova appear as small, round, opalescent bodies. Individual ova may be studied under a higher power lens—1-5 to 1-8 (Fig. 1—1 Natural size ; 2 head ; 3 tail ; 4 ova). These ova are well preserved when mounted in cast medium or in glycerine.

After the administration of certain drugs, the adult worm appears in the feces as a silky, slightly curved thread whose color is not constant.. The parasite's detection is facilitated by adding water to the feces and stirring to effect a perfect mixture which is then set on either a light or dark surface. A thin spread of diluted feces is in this way produced, and affords a favorable field upon which to find the parasite. Adult worms are preserved in 70 per cent alcohol. My specimens were first placed in alcohol, and later in glycerine for 24 hours, from which they were mounted in cast medium. Glycerine jelly is also a valuable mounting medium for animal parasites. The anchylostoma is known to be the cause of a large percent of deaths in tropical districts, and is of especial interest since Surgeon B. K. Ashford, U. S. A., has shown it to be most common in Porto Rico, and other West Indies isles.

TAPE WORMS.—Segments of these parasites are commonly passed with the stool, and their study and general characteristics differ in no way from where the parasite is expelled as a result of therapeutic measures. The freshly voided segments are first washed in water and then placed in 70 per cent alcohol for twenty-four hours, when they are transferred to xylol for twenty-four hours and then mounted as follows : A portion of a segment is placed on a slide, and teased to shreds. After a short exposure to the air (five minutes) a drop of Canada balsam is added and on it a coverglass placed. Prepared in this manner the ova are readily seen through a ⅔ lens, and when viewed under a ⅙ lens, both their outline and structure are apparent. Staining is accomplished by Delafield's hæmatoxylin and other dyes, but adds little, if anything, to the specimen's value. Study of the segment in its entirety is most interesting, but scarcely necessary in clinical work. It may be accomplished by placing a segment between two slides and clamping them tightly together. Under a ⅔ lens the segment may be studied, showing the uterus stuffed with ova.

To Detect the Head.—This being the portion of the parasite's study wherein most failures are experienced, and to which most importance is attached, I shall consider under the following heads: (1) Empty the bowels, by means of salines, so that no undigested food remains in the alimentary tract; (2) the administration of a vermicide; (3) follow in four to six hours by another saline; (4) when it is observed that the worm is beginning to escape from the rectum, the patient is directed to occupy a comfortable seat where the worm can pass into a clean vessel containing water; (5) it is all important that the patient sit on one commode from the time he observes that the worm is diminishing in size, until the entire worm is passed; (the nearer the head, the smaller the segments), when within a few inches, 10 to 12, of the head the worm appears as a pale slightly flattened thread and its segments are not distinct; (6) the head is the last portion of the worm to be passed, and as long as any part of the parasite is protruding from the rectum the probabilities are that the head has not yet escaped.

Given a specimen collected in this manner, add to it a quantity of water,stir gently with a glass rod, after which it will be seen that the worm falls to the bottom of the vessel, when decant one-half, or more, of the liquid, which is replaced by clean water. This washing is repeated until the worm is cleansed. The worm, with the water surrounding it, is now transferred to a clear glass dish 10 x 12 x 3 inches, which is placed on a white surface (towel) and all large segments are removed by a glass rod, drawing them over the edge of the dish, when they are allowed to fall into a second dish containing water; care being taken not to break the parasite.

After all large segments are removed, the head is usually readily detected, by the naked eye, floating amongst the remaining thread-like portions of the parasite. In searching for certain small parasites a hand-glass may be found for service. The head is transferred to 50 per cent glycerine and preserved for further study. In mounting parasite heads, a slide provided with a concavity of sufficient depth to accommodate their thickest portion, is most satisfactory. They are well preserved when mounted in Farrant's medium, cast medium, glycerine and glycerine jelly (Fig. 2—1 Natural size; 2 head; 3 ova).

TÆNIA ECHINOCOCCUS (DOG TAPE WORM).—Here the problem is somewhat different, as man is the intermediary host, and in him develops the head, or scolex of the parasite only. Each head is provided with a crown of hooklets, and many free hooks are often seen in connection with shreds of finely granular, yellowish membrane (Fig. 3). Hooklets, scolices and membrane from the cysts of the echinococcus are occasionally found in sputum, pus from abscesses, the fluid of cysts, feces and urine. Hooklets are best studied under a ⅙ lens, while the heads may be detected under a much lower power. It is these findings which enable one to recognize the parasite, and the hooks may be the only evidence present. In the study of this parasite a low power of illumination is necessary, and the skillful manipulation of both Abbe condenser and iris diaphragm afford great assistance. Products of the echinococcus may be mounted in any of the above mounting mediums.

TRICHINA SPIRALIS.—The larvæ of this parasite appear in the muscular tissue of man after the ingestion of uncooked, infected pork. They make their appearance early in the diaphragm, frontal, and muscles of the leg. The material to be studied is collected by the physician in the following manner: The site of incision is over the outer head of the gastrocnemius muscle, and after this area is surgically cleansed the parts are anæthetized by injecting a solution of cocoaine hydrochlorate. First inject the skin and then deeper structures down to the sheath of the muscle. When anæsthesia is produced an incision is made dividing all tissues to the muscle's sheath, which is grasped by a rat-tooth forceps and incised, after which a small portion of the muscle is dissected and placed in a vessel containing water. Glycerine and alcohol arrest all movements of the parasite. This wound is now closed and dressed antiseptically. A small piece of this tissue is placed on a slide and teased, by means of fine needles, until most of its fibres appear to be separated. The addition of a few drops of water to the specimen renders the teasing process less difficult. The slide is now viewed under a low power (⅔), and if trichinæ are present their rec-

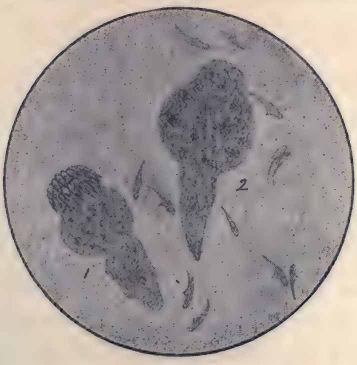

FIG. 3.—T. echinococcus. Scolex and hooklets (B. L., 1-6)

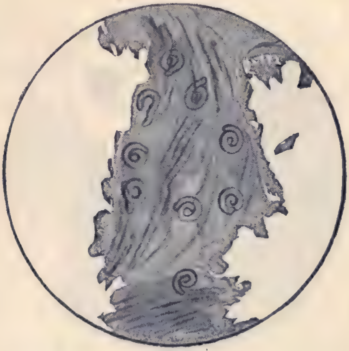

FIG. 4.—Trichina spiralis in muscle from outer head, left gastrocnemius. Twenty-first day of disease (Queen, ⅔).

ognition is easy (Figs. 4 and 5); however, a very low illumination is required. After a few weeks the trichina become incapsulated by the patient's tissues, when they appear as small solid bodies showing a parasite tightly coiled in their centre. Trichina are also well preserved by any mounting medium containing glycerine.

DISTOMA HÆMATOBIA (BILHARZ).—The adult parasite is probably located in the veins of the bladder, and there deposits its ova which find their way into the bladder or bowel, and appear in the urine or stools. Bilharz's parasite is a common cause of bloody urine in certain geographical districts. To detect the ova allow the urine to stand until all blood clots are collected at the bottom of the tube; (2) lift a portion of this sediment into a pipette and place a drop on the centre of a slide; (3) tease the clots as fine as possible, and evaporate nearly to dryness; (4) add a drop of cast medium, or glycerine, to the centre of the specimen upon which place a cover-glass and spread the medium by additional pressure. The specimen should be placed on a flat surface for twenty-four hours while the mounting medium hardens, after which time a permanent ring may be added. For rapid diagnosis the specimen may be mounted in water. Detection of these ova is best

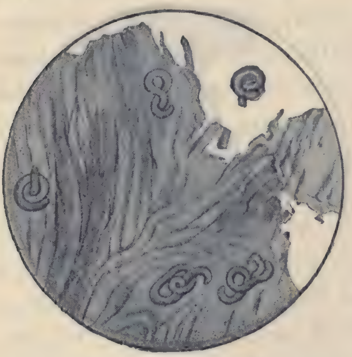

FIG. 5—Trichina spiralis. Eighth week of disease.

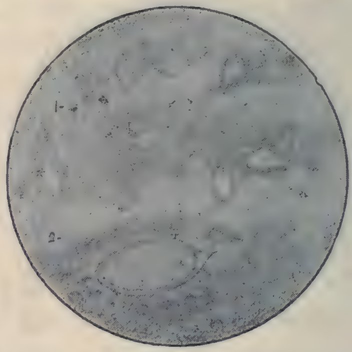

FIG. 6.–Bilharz's parasite. (1) Ova (B. L., ⅔); (2) ova (B. L., 1-6).

accomplished by the $\frac{2}{3}$ lens (Fig. 6). Individual ova may be studied under a higher power, when it is often possible to distinguish the contained embryo which varies in its appearance with the age of the egg. Influenced by temperature, these embryos are freed from their shell in from a few hours to several days after they are passed with the urine. The most immature ova are about 1-400 inch in length and 1-600 inch in breadth, while fully matured ova measure 1-280 inch in length and 1-226 inch in breadth. The study of ova in feces needs no special explanation.—*Am. Jour. Phar.*

History of the Compound Microscope in Pharmacy.

Compound microscopes with objectives and oculars fairly well corrected for spherical and chromatic aberration have been in use for nearly seventy-five years, but it is only recently that they have been extensively employed in pharmaceutical practice. This is due to the fact that pharmacy as a science is of recent origin; only within the last decade have the courses of instruction in the colleges of pharmacy been based upon scientific principles—at least this applies to the department of botany and its various branches,as vegetable materia medica, vegetable pharmacography, and powdered vegetable drugs. The leaders in pharmaceutical education admit that a good compound microscope is a part of the necessary equipment of the intelligent, competent practicing pharmacist. It is therefore much to be regretted that there are a number of so-called colleges of pharmacy from which students are graduated who have never used or even seen a compound microscope. Such graduates are wholly unfit for the duties of a modern pharmacist, because it is only through the intelligent use of this instrument that he is enabled to vouch for the purity of most of the vegetable drugs and many other substances used in his practice.

The advance workers in pharmaceutical vegetable histology abroad, as well as in this country, have employed the microscope for a number of years. A few eminent specialists of Germany and France have studied the histology of medicinal plants since 1825. The earlier German investigators also devoted much of their attention to the microscopical examination of foods and spices, textile fabrics, and various other commercial products. Some of this work was really Herculean, and it would be highly interesting to enter into a fuller discussion, but space will not permit. Those who have the time and opportunity can look upon the results of such work as recorded in German pharmaceutical and botanical journals and in the various reports on hygiene and city sanitation.

According to Pocklington, the use of the compound microscope in English pharmacy dates from 1850, when Dr. Hassell laid before the Botanical Society of London a paper on the histology of coffee and its adulterants. The microscope was introduced into American pharmacy a few years later. In England, as well as in the United States, the use of the compound microscope in pharmaceutical practice progressed very slowly, until about 1880 or a few years later, in spite of the earnest recommendations of a few leading teachers and investigators. Since 1880 some very energetic work has been done in America. Many of the investigations are, however, defective, and a mere repetition of the work already done in Continental Europe, particularly in Germany. It is much to be regretted that a truly scientific spirit does not more permeate English-speaking nations. The great majority of the scientific work done is primarily instigated and abetted by commercialism and hence does not attain to the lasting, far-reaching results of the work of our patient and careful German investigators, whose prime motive is to find out.

In 1853, Dr. F. Hoffmann recommended the use of the compound microscope in American pharmacy, calling attention to the value of this instrument in the examination of vegetable drugs and their adulterants. It was, however, not until some thirty years later that the compound microscope was used to any considerable extent in the study of vegetable drugs. It was looked upon as an impracticable instrument, having no commercial significance, and presenting no advantages over the simple microscope. Now and then some teacher or investigator would arise and reiterate the recommendations of Dr. Hoffman, or present some new phase of microscopic work in pharmacy, only to be met with the same indifference, if not actual opposition and ridicule. It is, therefore, little wonder that slow progress should have been made in the histologic study of medicinal plants.

In Germany the compound microscope found a steady use in pharmaceutical practice. In 1865 Berg published his excellent atlas illustrating the histology of the more important vegetable drugs, and even at this date there is nothing produced by an English or American investigator which equals this work.—ALBERT SCHNEIDER, M. D., in *Meyer Bros. Druggist.*

A Peep Through the Magic Glass.

S. P. SAUNDERS.

From paper on Sponges, read before the O. C. P.

I desire to give you a peep through this magic glass, but before doing so I shall try to describe the scene.

Before you lies a wide stretch of lively water of the most varied and brilliant shades of blue, green, purple, slate, brown and yellow. This remarkable diversity of colors is altogether caused by the nature of the bottom, as the water itself is absolutely clear and colorless. In the distance is a broad expanse of burnished and moving emerald. This indicates a bottom of white sand. Across the emerald run serpentine bands of celestial blue where the hurrying tide has cut a channel away. Away to the right is a marvelous picture of purple and slate grey intertwining and intermingling. The transformation is caused by a coarse sea-weed which thickly covers the bottom. On every side are patches of vandyke brown. Beware of them, as they reveal the whereabouts of the dangerous coral shoals. In front is a broad sheet of yellow brown, which indicates a rocky bar. You are going to this bar, as it is the home of the sponge zoophytes and numberless other forms of marine animals. The fresh tradewind is blowing, and has stirred up a short, lively sea; the mimic waves are dancing and leaping and tossing their foam-covered crests.

Although the water is transparent, yet its rapid and continuous movement prevents your seeing the objects on the bottom clearly. You may make out their form, but the objects appear also to be in motion, and it is impossible to recognize them. Fortunately the disturbance is only on the surface.

Now you take up your magic glass, place it on the water and immerse its glass-covered end a few inches, and look. What a wondrous revelation. A wide radius of bottom clearly shown, and the objects lying or growing on it are distinctly seen and magnified. This combined effect of water and glass forms a lens of great magnifying power. Many of you have observed a similar magnifying effect on fish when swimming in a glass globe filled with water.

The water glass magnifies with so much power that a five cent piece lying on the bottom twenty feet down can easily be seen.

Through the magic glass a new and beautiful world is revealed to your enraptured gaze. The rocky bottom is everywhere covered with lovely forms of marine life. Gorgeous Gorgonias, yellow and purple, fan-shaped or long-plumed and fernlike, waving and swaying with every pulse of the flowing tide. Corals, cone-shaped and erect, lofty carved columns, others like the branching antlers of the stag, others again broad and massive like those of the moose. Exquisite finger corals, embroidered and carved in the most skillful and delicate manner by the little marine architects. Round solid pieces like the human brain, the fully opened rose and dahlia. Pieces with spreading wings like a butterfly, and others that look like beautiful stalactites.

As the boat moves slowly onward you come to veritable coral grottos. All about them and in their limpid depths thousands of brilliantly uniformed fish are manœuvring. Sea anemones garland the sides of the shoal, and a chevaux de frise of sponges, sea urchins, black, white and yellow, covers the top and ambuscades the approaches.

As you gaze enraptured into these moss-lined coral caves, it requires no great stretch of the imagination to conceive them to be the enchanted retreats of the fabled siren and mermaid. As you proceed, troops of great yellow and brown star-fish appear, and huge conchs, bearded with green and russet sea-weed.

Occasionally a small body, with staring eyes and eight long tentacles, is seen prowling slowly around—'tis the repulsive and dreaded octupus. Or perhaps a great broad, black monster, with wing-like fins and long whip-like tails comes boldly swimming along—the ray, or devil-fish.

All about are red and black sponges, many of them two feet in diameter. Some of curious form and structure, others plume-like and feathery, and over all the bottom are patches of green and red and brown algæ, the ferns and flowers of the sea.—*Can. Phar. Jour.*

HE HAS 21 VOLUMES.—I enclose check for subscription. I have been a subscriber from the start and do not wish to let it lapse.—Jos. Jackson. We appreciate this kind of subscriptions.

The Germ of Cancer a Protozoan, a Single Cell.

DR. HARVEY R. GAYLORD, BUFFALO, N. Y.

We succeeded in cultivating, with comparative regularity, directly from cancer, from fluids which were in contact with cancer and from experimental animals these organisms,the protozoa. We are prepared to state that all the organs, including the blood, taken from all regions in all cases dying of cancer, including sarcoma and epithelioma, contain large numbers of organisms. We have likewise observed in all cases of carcinoma and sarcoma thus far examined that the organisms, especially the younger forms, can be detected in the peripheral blood.

The quarter-grown forms of the organism of cancer conform very closely in appearance with the amœboid bodies found in the blood by Pfeiffer and Reed after vaccination and in cases of small-pox. The questiom of the appearance of these organisms and the utilization of this fact as a means of diagnosis already forms the subject of a piece of research in our laboratory.

Fourteen guinea pigs inoculated in the peritoneum with peritoneal fluid containing the organism gave an average length of life of 58 days ; 4 inoculated in the peritoneum with cancer mush gave an average length of life of 57 days ; 11 inoculated in the peritoneum with dried cancerous lymph nodes, gave average length of life of 45 4-11 days ; 6 guinea pigs inoculated with peritoneal fluid and lymph nodes from animals which were infected in the above manner, gave an average length of life of 29 days —a little more than half the length of time for the animal inoculated directly from man.

This unquestionably shows the increased virulence of the organisms after passing through an animal. We are continuing these experiments in modified form and shall report on them later.

The average length of life for rabbits inoculated in various regions with the different forms of material used shows the greater resistance of this animal to infection. In our most recent experiments we have succeeded by growing the organism in a collodion sac in the peritoneal cavity of a rabbit, in so increasing the virulence of the organism that a healthy rabbit inoculated in the ear-vein died of general hæmatogenous infection from the organism after a period of 15 days.

It will be seen from these experiments that animals are readily infected when inoculated with carcinomatous material as well as pure cultures of the organism. The peritoneal fluid used in all of these inoculations was bacteriologically sterile and consisted essentially of a pure culture of the organism. A guinea pig and a rabbit which were inoculated with filtered serum from which the organism had been removed, gave a respective length of life of 304 days and 164 days. The organs of these animals were free from parasites.

The microscopical pathological findings in these cases were generally uniform. All the animals were greatly emaciated and presented, on opening the abdominal cavity, collapsed intestines, reddened peritoneum, enlarged peritoneal lymph nodes and a moderate amount of clear straw-colored fluid. The lungs were dark red in color, collapsed, heart containing but a small amount of blood, spleen enlarged and reddened, liver in many cases hyperæmic, and the kidneys generally injected.

In almost all cases, a fresh examination was made of the peritoneal fluid, the organs, and the blood; and whenever made, large numbers of the parasites could be readily detected, as already described.—*American Journal of Medical Sciences.*

LATE.—Owing to a sudden and unexpected removal of our office, our work was disturbed and thrown behind in a troublesome manner but we are now catching up.

Notes on Microscopy.

F. SHILLINGTON SCALES, F.R.M.S.

Royal Microscopical Society.—On November 21st, Mr. Wm. Carruthers, F.R.S., President, in the Chair. Mr. Nelson exhibited and described an erect-image dissecting microscope by Leitz, sent for exhibition by Mr. Baker. The erection of the microscope image, effected by means of Porro prisms, was first described by Behrens in the Journal of the Society in 1888. This instrument was valuable as a dissecting microscope ; it was provided with hand-rests and three objectives having a very long working distance. Mr. Disney exhibited a diffraction plate, having the lines ruled in concentric circles, by which the diffraction bands were separated with great clearness. The rulings were about 7,000 to the inch. He also exhibited a steel brooch, the surface of which had been ruled in the same way. The method by which the lines were produced was at present a secret. The articles were of English manufacture, and had been lent to him by Messrs. Townson and Mercer. Mr. C. F. Rousselet exhibited an electric lamp for use with the microscope. After six months' trial he had found it very satisfactory for work with low and medium powers. It was manufactured by Edison Swan Co., and was called the "Focus" lamp. The President called attention to the exhibition that evening of a number of slides from the Society's cabinet, prepared by the late Dr. Carpenter in connection with his investigations into the shells of the mollusca. Mr. B. B. Woodward, who has given much attention to this subject, had also brought down some valuable preparations for exhibition. Mr. Vezey, at the request of the President, read a short abstract, copied from the Report of the British Association for 1846, which was a *resume* of the original communication on shell structure made to that Association by the late Dr. Carpenter, to illustrate which the slides exhibited were prepared. The President then called upon Professor Charles Stewart, who, having referred to the views held upon shell structure at the present day, and taking the common pinna shell as an example, proceeded by the aid of drawings on the blackboard to demonstrate how its structure was built. Besides studying the sections usually made, he recommended that the shells should be broken and the fractured surfaces examined, if a correct idea of the formation of the shells was to be obtained.

FRESHWATER ENTOMOSTRACA.—Mr. D. J. Scourfield, in the Proceedings of the South London Entomological and Natural History Society, calls attention to the value of Entomostraca in experimental biology. "Their commonness in all parts of the country, their transparency, the ease with which they can be isolated and reared under all sorts of conditions, ... mark out the Entomostraca as particularly well fitted for observation in connection with even the most fundamental biological problems of the day." He adds: "We badly want detailed studies on local faunas, on the seasonal distribution and variation of different species, on the faunas of various types of ponds, on the food of the most abundant forms, and many similar subjects."

J. SWIFT & SON'S CONDENSERS.—Messrs. J. Swift & Son have submitted for inspection two excellent condensers of their manufacture. The first is apo-chromatic, and has a numerical aperture of .95. Its aplanatic exceeds, however, according to our measurements, .90; and as the value of a condenser for anything approaching critical work depends on the aplanatic cone of light that it transmits, it will be seen that this condenser is eminently fitted for such work. As an apo-chromatic system it is, of course, distinctly freer from color than even the best achromatic system can be made, and this is very manifest when using high-angled lenses. The power is about one-third of an inch, and the price, without mount, $20. We can recommend this condenser for all high-power work, and it is of interest to remember that, so far as we are aware, Messrs. Swift & Son share with Messrs. Powell & Lealand the distinction of being the only makers of apo-chromatic condensers throughout the world. The second condenser is achromatic, and is an oil-immersion with a numerical aperture of 1.4 and an aplanatic cone that we estimate as exceeding 1·3. The corrections of this condenser are also excellent, and the working distance is ample, even with a thick slide. The power is about ¼-inch, or ¾-inch with the front lens removed, and the price without mount is $19. Both condensers are constructed with the newer makes of glass manufactured in Jena. It says much for the enterprise, and the keen competition perhaps, of our English opticians that we should have been able to notice in these columns within a short period three different immersion condensers of high excellency by three leading makers.

TARIFF EFFECTS.—American prices would scarcely serve for the English market, an apo-chromatic 1-12-inch oil-immersion objective of N. A. 1.3, for instance, being priced at $120 = £24, and the corresponding objective of N.A. 1.4 costing $160 = £32. Zeiss' price for similar lenses are respectively £15 and £20. The stands are built entirely upon the Continental model, which is closely adhered to, not only in the horse-shoe stand and in the fine adjustment, but also in the later Continental forms of sub-stage arrangements.

THE ORDINARY COLLODION.—Flexile collodion is used medically and contains castor oil. We would recommend, however, Schering's Colloidin, which is largely used by microscopists for section cutting. It can be obtained in chips or solution. A bottle containing 50 grams of the latter can be obtained from C. Baker for 30 cents. Beech-tar creosote is to be preferred, especially for cleaning colloidin sections, but coal-tar creosote would do equally as well, provided it is equally white.

Extracts From Postal Microscopical Society's Note-Books.

Bacteria in Water.—A few weeks ago I noticed that a glass ornament on the sideboard in my dining-room contained some flowers in rather cloudy water, and guessing that carelessness had led to the water being left too long I examined a drop of it for infusoria under a moderately high power. I was surprised to find that the water was absolutely thick with every kind of schizomycetes, micrococci, bacteria, bacilli, spirillæ, vibriones, and leptothrix forms, besides a few paramœcia, monads, etc. The spirilla forms were unusually plentiful and active, and several zoogløean masses of bacteria were noticable. I mounted some slides from the liquid, of which the accompanying is one. The microbes are stained with logwood on the cover-glass and mounted in balsam. They will afford a test for the excellence of the objectives, condensers, and fine adjustments of our members' instruments. The vibriones have taken the stain best, the other forms indifferently. By the way, though balsam-mounting is always recommended in the text-books, bacteria show much better mounted dry on the cover-glass. At least I find it so. A good quarter-inch objective, which will bear a high amplification, shows well-stained objects perfectly well.

Examining Bacteria..—If a slide is prepared for photo-micrography, gentian violet is the most suitable stain. Take a drop of the bacterial solution on a platinum wire, and touch with it a clean cover-glass that has been washed with water and alcohol. Then take a second glass, rub the two together so as to get a nice clear film on the glasses. Then filter some fuchsine in aniline, and place the cover-glasses in the pigment. Occasionally take out one with the forceps, and if stained wash well in alcohol.

Now stain again in the methyl blue, wash in dilute sulphuric or nitric acid, then again in alcohol, and when the cover-glasses are dried with a piece of filter-paper or blotting-paper they can be mounted in balsam. It seems a tedious process, but when understood is very easy. I often examine spleen for tubercle bacilli by this method in fifteen minutes. A splendid double stain can be purchased from Messrs. R. & J. Beck, of Cornhill, London, for one shilling per bottle, which saves great work, but the solution must be warmed before use.—*J. Swift Walker, M. D.* Logwood is not a good stain for bacteria. Some of the aniline stains, such as methyl blue or gentian violet, give much better definition. A preliminary fixation by heat or absolute alcohol is also desirable. Mr. McGhie would then have no hesitation in mounting them in Canada balsam, as the staining would be very pronounced.

SCALES OF CLOTHES-MOTH.—This slide may be considered a trivial one to send around; but though the scales are not rare, they exhibit much beauty of marking in the way of striæ and villi when examined under moderately high powers, besides making a charming dark-ground slide under $\frac{2}{3}$ inch or 1-inch objectives. I have included the slide, however, principally because I think these scales exhibit better than any others the evolution of the insect scale from the simple hair, or rather the probable lines on which it took place. The piece of wing on the same slide shows well the distribution of the scales; flatest on the centre of the membrane, and shading off into bundles on the edges. In the nervures a crooked system of vessels is perceptible, and these may be traced right through to pedicles of the tufts of bristles at the wing's point, the function being, I believe, to supply the scales with the liquid which, according to Dr. Royston Pigott, is found between the upper and lower membranes of the scales. I am writing without the book, but think this is so. There is certainly, as can be clearly seen with a good objective of wide angle, an intricate system of capillaries feeding every pedicle in the membrane.

ANTENNÆ OF COCKCHAFER.—Of all points shown by antennæ, I thing there are not any more peculiar and interesting than those of the organs of the cockchafer, with their leaf-like expansions, folding out upon one another like the sticks of a fan. This slide contains two of these lamellæ mounted in balsam. Carpenter (7th edition, 1891, p. 912) says of these markings: "A curious set of organs has recently been discovered in the antennæ of many insects, which have been supposed to constitute collectively an apparatus for hearing. Each consists of a cavity hollowed out in the horny integument, sometimes nearly spherical, at others flask-shaped, and again prolonged into numerous extentions formed by the folding of its lining membrane; the mouth of the cavity seems to be normally closed by a continuation of this membrane, though its presence cannot always be satisfactorily determined; whilst to its deepest part a nerve-like fibre may be traced." The cavities may be viewed from above under a magnification of 1,000 diameters, and also the aspect they present when seen partly sideways at the edges of the lamellæ. A memoir of the structure by Dr. Hicks is to be found in the "Transactions of the Linnæan Society," xxii. page 147.

PADDLE-LEG OF DYTISCUS MARGINALIS.—This needs little notice. Dytiscus marginalis is one of the best-known of the beetle tribe. A friend of mine, who has a large conservatory containing an artificial pond—the waters of which, by the way, have developed a remarkably rich growth of diatomaceæ—found a fine large specimen of the larval form of this formidable insect that was working great havoc among the tadpoles of the aquarium. He kept it alive in a glass jar for several weeks, and we were able to watch its habits. Its fierceness and voracity correspond with its repellent aspect. This is, of course, the hind leg, which is specially adapted for swimming by the flattening of the tibiæ and tarsi, and by their being furnished with rows of long bristles. The fore-legs of the males are even more interesting, the basal joints being expanded into broad flat plates, furnished with curious sucker-like discs, which secrete an adhesive fluid similar to that in the foot of the housefly.

EPIDERMIS OF LEAF OF AURICULA.—This was stripped from the underside of a leaf, treated with dilute nitric acid, and stained and mounted in Canada balsam. Its main interest lies in the glandular hairs, which are best seen with a ⅛-inch objective, and in the stomata.—M. T. McGHIE.

I have been much interested in some of Mr. McGhie's slides, and always like to see members prepare their own slides.—ED

TUBERCLE IN SPLEEN.—A high power objective is necessary to properly display the stained Bacillus tuberculosis. I have examined the section with a 1-12-in. oil-im. and fail to detect any bacilli. The abbreviations at corner of label of slide—which I construe to mean : par. = paraffin, as embedding agent ; al. car. = alum carmine,as stain ; or. =oil of origanum, as clearing agent ; C.B. = Canada balsam, as mounting medium—represent a method of preparation not calculated to demonstrate tubercle bacilli. The nuclei of the tissue are well stained, and the tubercle, which in the spleen is always secondary to tubercle elsewhere, is seen as miliary granulations, but no bacilli are visible. The bacilli are not readily stained in tissue such as this. The Ziehl-Neelsen method is the best. The special advantage of this method is that not only does it demonstrate the tubercle bacilli, but it is at the same time diagnostic, as no other bacilli are stained in this way except the bacilli of leprosy. The method is as follows : the sections are transferred from weak spirit to carbolic fuchsine stain for fifteen minutes, then decolorized in weak sulphuric acid (sulphuric acid, 10 c.c.; distilled water, 30 c.c.), and afterward rinsed in 60 per cent alcohol and washed in a large quantity of water to remove the acid. The sections may then be counterstained with methyl blue then dehydrated in absolute alcohol, cleared in cedar oil, and mounted in Canada balsam. The bacilli will then be stained red and the surrounding tissue blue.—*J. R. L. Dixon.*

EDITORIAL.

GOULD'S ILLUSTRATED DICTIONARY OF MEDICINE.—As a *vade mecum* of everything pertaining to the microscope, either for the amateur or professional worker, Gould will be found most satisfying. Under the definition "Microscope" is an illustration with each part named, and each term applying to the science is properly defined. Under the heading "Stains" is an elaborate article giving all Fluids used for fixing and hardening, Media for examination and preservation, etc., and methods employed in biologic investigation. This was written by an expert, and submitted to a practical microscopist before printing. The formula and uses of each fluid or preparation is carefully stated and its synonym mentioned, together with the authority recommending its use, if such use be doubtful.

PERSONAL.—The Popular Science Monthly for May opens with an article by Dr. W. J. Holland, Director of the Carnegie Museum at Pittsburg, describing the institution which Mr. Carnegie has so liberally endowed, and which it is said he intends to make the greatest institution of its character in the world. The article is fully illustrated, and includes plans for the enlargement made possible by Mr. Carnegie's recent gift of $3,000,000. Dr. Holland has long been one of our subscribers.

EXHIBITS.—The Photography and Microscopy section of the Franklin Institute, Philadelphia, proposes to hold the photographic exhibition early in 1902, and lasting about three weeks. Photo-micrography and Microphotography are included. Further particulars from F. M. Sawyer, Secretary of the Committee.

Parasites of Man.—Through the kindness of Professor Henry Kraemer of the Philadelphia College of Pharmacy, who loans the cuts we are able to present the paper of Dr. L. Napoleon Boston, the Bacteriologist to the Philadelphia Hospital and Demonstrator in the Medico-Chirurgical College, which paper was read in the Philadelphia College of Pharmacy, April 16, 1901. In connection therewith, he exhibited slides of these parasites of different stages of development. Those who discussed the paper commended its practical importance. Professor Kraemer secured the paper for publication in the American Journal of Pharmacy and made the photo-engravings from the slides.

MICROSCOPICAL MANIPULATION.

Detecting Human Blood.—A new and seemingly important plan has been brought out by M. S. Cotton in Bull. Soc. Chimique de Paris. Blood will liberate oxygen from hydrogen peroxide. Using 1 c.c. of blood with 250c.c. of hy. per., he obtained for man, 580 to 610 c.c. O., for horse and pig, from 320 to 350 c.c.; for ox, 165 to 170; for guinea pig, 115 to 125; and, for sheep, from 60 to 65 c.c. This large excess in man over all the lower species would seem to be of diagnostic value.

Microscopical Examination of Substances in Small Quantities.—Professor Kraemer has found by experiment, difficulties in the work which prevented uniform crystallizing of the same substances. With solutions of alum in watch crystals, the crystals separate in 3 or 4 different forms apparently of the same system, though possibly of different ones. Calcium oxalate occurs in monoclinic and tetragonal systems. Microscopic physical conditions must be taken into account in work of this kind.

A NEW METHOD OF COUNTING THE WHITE CORPUSCLES has been devised by Kourloff (*Vratch*). It is a dry method, and consists in drawing the blood into a graduated pipette, depositing a thin film on two cover-glasses, whose surface is measured by a network of lines. The white cells are then counted and the area measured by means of the movable stage and Ehrlich's diaphragm. This method allows the operator to work without haste and the results can be verified at any time. The writer asserts that he can count from 1,000 to 2,000 more white cells than by the Thoma-Zeiss cell, the dilutent in that method changing and destroying some white cells.

STAIN FOR ELASTIC FIBERS IN SPUTUM.—L. Michælis (*Deut. Med. Woch.*, April 4, 1901) gives the results of mixing various basic stains with resorcin, all being equally effective in staining elastic fibers in sputum. He prefers fuchsin, resorcin, and ferric chloride, which produces a dark blue stain. The suspicious part of the sputum is spread between two cover-glasses and allowed to dry in the air. A cover-glass is then immersed in a glass containing the stain, which can be used a long time. The alcohol in the staining solution acts as a fixing agent, and in half an hour the specimen is removed, rinsed in water, and placed in a three-per-cent hydrochloric acid solution until it appears colorless. It is then dried and covered with a drop of cedar oil. Examine with a microscope, and the elastic fibers will be stained a dark violet, while all other fibers, such as wool, cotton, and vegetable fibres from food, are not stained. This method gives us another means of making an early diagnosis in tuberculosis, as there is no element in the sputum of bronchitis which gives this reaction.—*Med. Age.*

QUICK METHODS OF STAINING THE GONOCOCCUS.—In the *Zeitschrift fur Wissenschaftliche Mikroskopie*, Unna gives the following quick method of staining gonococcus for diagnostic purposes and immediate examination. On a glass slip, let fall a drop of from a half to a 1 per cent alcoholic solution of anilin red, spread and dry quickly. A droplet of the suspected matter is then put on the slip, on the spot where the red was applied, a cover-glass put on, and the slip transferred to the stage of the microscope and examined. The gonococci, if present, commence instantly to take up the coloring matter, and may thus be easily discovered.

LIMPID SOLUTION OF COPAL FOR MICROSCOPICAL USE.—The writer hereof has long used the following method of preparing gum copal for microscopical purposes. It furnishes an absolutely colorless and limpid preparation: Dissolve 1 part of camphor in 12 parts of sulphuric ether, add 3 parts of pulverized gum copal to the solution. Cork the flask tightly and set aside, with an occasional agitation until the copal is partly dissolved and partly swollen to its fullest extent. Now add ¼ part of rectified oil of turpentine and 4 parts of alcohol 96 per cent, and agitate briskly. Set aside for a week or so, giving the flask daily occasional lively shakings. At length the copal will be found entirely dissolved, and the contents of the flask separated into two layers, one of which, the lower, is dark, thick and possibly full of sedimentary matter, while the upper is limpid, clear as a crystal and rich in copal. Syphon off or decant the latter for use, and if too thin the solvent may easily be driven off. While the residual matter in the flask still contains considerable copal, which may be extracted by repeating the operation, it will be found more economical to operate with a fresh charge of copal, when more is wanted.—*Nat. Drug.*

STAIN FOR URINARY DEPOSITS.—For staining the morphological elements found in urine, the best stain that we have yet found—and we have been experimenting in this direction for a quarter of a century—is boro-eosin. It is prepared by dissolving one gr. of borax in 19 ccm. of distilled water on the one side, and on the other, 50 cgm. of eosin in a mixture of 10 ccm. of alcohol and 40 ccm. distilled water, and mixing the solutions. Filter and keep in a glass stoppered bottle.—*Nat. Drug.*

BIOLOGICAL NOTES.

Classification of Pollens.—The subject has been to me of great interest, and after 45 years of constant though intermittent examination, it may be interesting to some to compare a few notes. Now the shapes of pollen are doubtless the first striking facts, and I have been struck by the identity of shape of all the Compositæ—viz., globular and spiked like the horse-chestnut hull. But the forms are very numerous. There are many four-keeled or four-lobed ellipsoids, the breadths being from ½ to ⅓ of the lengths. Then, of course, the sizes vary immensely; the evening primrose and the poinsetta are 1-160in. in length, though totally different in shape. The azalea is the smallest I have. It is spheroidal, and only 1-2200in. Mould spires I measure to be 1-8000in., and so there is endless variety of size, shape, color, and sometimes surface markings—to wit, the geranium and the passion flower. I am curious to know whether anybody has hitherto noticed the similarity of the shapes of the pollen of all the Compositæ. I may mention that I always use a ¼in. objective and an eyepiece giving me 18-1000in. as diameter of field always lighted by a parabolic reflector from below, getting the pollen on a common slide. Habit has given me great rapidity of examination, and the colors and markings come out beautifully. I have had hours of great enjoyment from this alone.—*W.J.S. in Eng Mech.*

SMALL-POX.—The State of Michigan is pretty well "peppered" with the disease, it now being present in one hundred and two places, and it has existed, since January 1, in one hundred and eighty-two places.

During the ten years from 1890 to '99 there occurred in Michigan 710 cases of small-pox of which 134 died; a fatality of about 19 per cent. During the single year 1900, there occurred 608 cases of small-pox of which 8 died, a fatality of a little over 1 per cent. At the close of the first quarter of 1901, final reports have been received of seventy-seven outbreaks, showing that 500 cases occurred, including 7 deaths, a fatality of a little less than one and a half per cent.

BACTERIOLOGY.

A CONSTANT MICRO-ORGANISM IN SCARLET FEVER.—Baginsky and Sommerfeld (*Berl. klin. Woch.*, 1900, No. 28 u. 29; *Manat. fur. Prak. Dermat.*, Mch., 1901) state that in all cases of scarlatinous sore-throat, a prevailing streptococcus, sometimes in pure culture, more usually together with other cocci, is present. In all their investigations of scarlet fever in children a streptococcus was found in all the organs, also in the blood and bone-marrow. These micro-organisms appear as a round coccus with a single round nucleus, forming a short or long chain. It grows in alkaline bouillon, agar, blood-serum, etc. It does not liquefy gelatine. It stains slightly with all anilin stains. Specific characteristics have not yet been ascertained.

TUBERCLE BACILLI IN BUTTER AND MARGARIN.—Markl (*Wiener Klin. Woch.*, No. 10, 1901) states that during the past five years many investigators have found virulent tubercle bacilli in market butter. The question is, what percentage of market butter contains bacilli, and what is the danger of eating butter? Investigators differ widely in different localities, so the author made experiments with the market butter of Vienna. He used the Obermueller method, ejecting the centrifugated melted butter into the abdominal cavity of animals. In all, he inoculated forty-five guinea-pigs, and not one died of true tuberculosis or showed signs of the disease ; one case proved to be pseudo-tuberculosis. Ten animals died of peritonitis, but none injected with margarin died from peritonitis. In the case of pseudo-tuberculosis he found a long acid bacillus taking Gram's stain, and which he considers the cause of pseudo-tuberculosis as well as Petri's and Hormann-Morgenroth's bacilli.—*Med. Age.*

THE CHEMISTRY OF CANADA BALSAM.—Tschirsch (*Archiv der Pharm*) publishes the results of his researches on this balsam. He finds the acid in a number of samples he has examined to lie between 82.2 and 86.1. The saponification number varied from 194.2 to 197.7. Among the resin acids present he finds canadinic acid, $C_{19} H_{34} O_2$, and canadolic acid, $C_{19}H_{28}O_2$. Two isomeric amorphous acids, a- and b- canadinolic acids, were also found to be present in considerable quantity. Canaderesene, $C_{12}H_{40}O$, was also isolated. By the distillation of the balsam with steam a small quantity of an essential oil, boiling between 160° and 167° C., was obtained.

MICROSCOPICAL SOCIETIES.

SATURDAY NIGHT CLUB OF MICROSCOPISTS.—A reception of the Club was held at Franklin Institute Hall, Philadelphia, on Saturday, December 15, 1900. There were present, besides the regular Club members, a large number of invited guests. The speaker of the evening was introduced by the President, Dr. Joseph C. Guernsey, with the following remarks: "It is the custom of our Club to occasionally invite outsiders, that they may enjoy with us some of our rich intellectual feasts ; and we feel that to-night we are offering an exceptionally entertaining and instructive treat in presenting 'Color Photography.' It has been said to me, 'You are a club of microscopists; therefore, what have you to do with color photography?' I shall refer this question to Mr. F. E. Ives, whose persistent investigations of photography in all its branches, extending twenty years, have culminated in the triumph he is about to exhibit to us. Mr. Ives then proceeded to demonstrate the "kromskop" system of recording and reproducing colors by photography, with special reference to its application in pathology. The importance of color in the diagnosis of many diseased conditions, and the desirability of obtaining and preserving for future reference and study the appearance as to color as well as form in many diseased conditions, having long been felt by the medical world. Both upon the screen and in the kromskops, color photographs of pathological subjects were shown, and also examples of a different character, such as landscapes, portraits and works of art. Mr. Ives gave a concise exposition of the principles of the system, explaining the fact that it bore the same relation to color vision that the moving picture apparatus does to life motion, and the phonograph to sound—each system producing in the first instance, not a reproduction of the thing itself, but a record, which was afterwards translated to the eye or ear by means of a special device. A special feature of the demonstration was a description of the methods by which the process, first successfully only as a laboratory experiment, has been reduced to such a degree of simplicity and precision that it is coming into general practical use.—NATHAN SMILIE, M. D. *Secretary.*

NEW PUBLICATIONS.

Detroit Medical Journal.—April witnesses Vol. I, no I of a new 32 pp. periodical. The frontispiece and first article is by our old friend, Dr. W. P. Manton, Editor of *The Microscope* in the days when it thrived in Detroit.

Algae.—A catalogue of 734 publications, with prices in marks, has been issued by W. Junk, Second-Hand Bookseller, Berlin, N. W. 5, Germany, devoted entirely to algæ, diatoms and desmids. I have written for ten copies to send to subscribers who apply therefor. The first ten who apply will recieve them and others will be supplied from a later lot, after I see how many are desired.

Hypnotism. By L. W. DeLaurence, Pittsburg, Pa. 8vo. 256 pp. 18 plates. Owing to these beautiful illustrative plates, this is the best book on the subject which we have seen. The book is written for physicians and scholars, as well as others. We do not recommend that others try to use this great but little-understood force in Nature, though there is no harm in reading up the subject. The author goes into the broad field of suggestion and its application in various ways such as in dentistry, mental healing, etc. He treats also that curious topic of self-hypnosis. As regards crime, his statements are important in a Medico-Legal sense. He seeks to connect the doings of Indian fakirs with hypnotism and writes a chapter on magnetic healing. The paper and printing are excellent but the cover a little flashy. The author's picture appears in many of the plates and yet he seems to think that his good-looks warrant it as a frontispiece also. He is rather good looking. His book comes from Hennberry Company, Chicago.

Atoms and Energies. By D. A. Murray. 12 mo. 202pp. $1.25. This is the discussion of the elements of physics. The author does not blindly accept the theory of the ether but finds all nature included in (1) an attractive energy such as is seen in gravity, (2) an expansive energy as is shown by heat, (3) what we call matter composed of atoms. With these three, he proceeds to explain cohesion, adhesion, chemical affinity, the solid, liquid and gaseous states of matter, latent heat, the transition from liquid to gas and the expansion of water by freezing. Energy he calls an entity and not a mode of motion. This book is worth the attention of every naturalist and philosopher. Curiously, he finds that atoms are not all of the same size or shape. We shall hear from Mr. Murray again with much satisfaction. He writes from Ottumwa, Iowa. The A. S. Barnes Co. Publishers.

Key to Magnetic Healing.—A handbook for ministers, doctors, lawyers, teachers, students, business men, nurses, and others, by Professor J. H. Strasser, of the New Ulm Inst. of Magnetic Healing. This book comprises the history of magnetic healing, the theories of vital magnetism, mental science, hypnotism and telepathy, and practice of magnetic healing. This book seeks to bring the subject down to common sense avoiding mystery, confusion, superstition. The fundamental principles of magnetic healing are fully demonstrated. This book gives the reader entirely new and higher views about the workings of his own body and mind, and shows how to get well, and how to keep well. It gives the most advanced theory, and the correct practice of magnetic healing. Price $5.00 with a reduction to our subscribers equaling our subscription.

MICROSCOPICAL QUERIES.

A subscriber writes: "I have made several sections of coal, but have so far been unable to bleach them." Please let us have your experience therein or abstract of any printed instructions to which you have access.

Is there anything I can use to thin the cedar oil without unduly altering its refractive index? I can, indeed, manage with a Rousselet compressorium fitted with very thin cover-glass, but it is not always practicable to transfer a minute object from the slide it happens to be on.

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On the Resolution of Amphipleura Pellucida, etc.
With a Dry Lens and Axial Illumination.

A. A. MERLIN, F.R.M.S.

(*Read November 16, 1900*).

Many members of our Club have been long familiar with the structure of *Amphipleura pellucida* as revealed by oil-immersion objectives of the highest class and aperture. The point to which I now beg to call your attention is the accomplishment of the resolution of normal specimens of this diatom by means of Zeiss's dry 4 mm. apochromat, and a 5-6ths solid axial cone from Powell's adjustable apochromatic condenser.

I was led to attack the *A. pellucida* with the above specified optical arrangement through having remarked the great strength of the resolution yielded by some realgar-mounted specimens under the Zeiss 3 mm. of N.A. 1·4 and a solid axial cone of about N.A. 1·2 from an oil-immersion condenser. I must confess that the exact theoretical resolving limit of an object glass of N.A. ·95, as given in the table on page 85 of Carpenter's "The Microscope and its Revelations" (Seventh Edition, Edited by Dallinger, 1891), had at the time escaped my memory, otherwise it is extremely improbable that any such attempt would have been made.

It was found, however, that in actual practice the 4 mm., used in conjunction with a 27 compensating ocular, with which eyepiece the image remained perfectly sharp, would steadily show the fine transverse striæ on realger mounts, although the lineation was much fainter than that revealed by oil-immersion lenses of large aperture.

The resolution of valves in realgar having been accomplished, dry and balsamed specimens were next examined, and to my very considerable surprise, both proved resolvable with the 4 mm. and 5-6ths axial cone. In balsam the striæ appeared as extremely faint, but clean, gray lines of great fineness. Although most faint and difficult, they have been held with perfect certainty for short intervals, slightly averted vision proving of material assistance in this instance.

In order to satisfy myself that the true striæ are indeed rendered visible by the 4 mm., a valve has been first arranged to exhibit them under that lens, an oil-immersion being afterwards substituted, when the lines have been found to be identical, and of the same fineness and distance apart with both objectives, the only difference being in the strength of the resolution afforded by them.

The significance of the above results is at once apparent on turning to the aperture table, where we find that N.A. ·96 is given as the *limit* of resolution of the *A. pellucida* ;

hence it would appear that the Zeiss 4 mm. of N.A. ·95 (nominal), illuminated by a 5-6ths solid axial cone, is in practice capable of revealing structure just within the theoretical resolving limit of a lens of N.A. ·96, and that this resolution is attainable not only in media of high refractive index, but also in balsam and with dry mounts.

Now the 4 mm., although its guaranteed minimum N. A. is only ·95, as a matter of fact is quite likely to possess an N.A. of ·96, or even one slightly in excess of this, so that theoretically, without any deduction for technical imperfections, it would be just capable of resolving the *A. pellucida*; but that this theoretical limit should be actually attained by a lens with strictly axial illumination, and on specimens mounted in media of both high and low refractive index, cannot be regarded as a very extraordinary and interesting result, it having been hitherto considered that the transverse striæ of the *A. pellucida* are in actual practice only just discoverable with dry achromatic lenses of N.A. 1·0, and that only on the specimens mounted in a medium of about 2·4 refractive index when illuminated by oblique light in one azimuth along the valve.

Perhaps not the least interesting and satisfactory outcome of these observations is the indication that a dry lens is capable of working its full theoretical capacity on balsam-mounted objects, the resolution only becoming more conspicuous in media of higher refractive index.

In addition to the *A. pellucida* many other forms have been recently studied with the 4 mm. and a 5-6ths solid axial cone. The most difficult structural features have not been seen with a lesser cone, but we do not assert that they may not possibly be so resolved, although the results of my observations have strongly inclined me to the belief that, with axial illumination, structure just within the capacity of the lens employed can only be seen with a very large cone. It has appeared to me that closing down the cone, while greatly strengthening the contrast of the coarser, causes the finer detail to disappear altogether, and materially reduces the separating power of the objective. With reference to this matter the following experiment may prove interesting :—Arrange a Cherryfield *Navicula rhomboides*, mounted in a mixture of monobromide of naphthaline and balsam, under a good semi-apochromatic ¼″ of N.A. ·77, and 27 ocular, so that the valve shall lie longitudinally along and on the sharply focussed edge of the lamp flame. With slightly under ¾ cone the longitudinal striæ will appear conspicuous throughout the entire length of the valve, while the closer transverse striæ, although they may be seen to a certain extent, are far less satisfactorily defined, no thoroughly clear separation being apparent. Now replace the smaller by a 5-6ths cone. The coarse strongly-defined longitudinal striæ disappear, and at the first glance all structure may seem to have disappeared with them, but a little careful scrutiny will reveal the presence of a faint dotted resolution, the transverse divisions of which are as fully and cleanly shown as the longitudinal.

I am aware that the results dealt with in this paper cannot meet with general acceptance until they receive confirmation at abler hands than mine, nor indeed would it be desirable that they should be so accepted, involving as they do important theoretical considerations, until independent practical experience shall have placed their truth beyond doubt.

The subjoined notes on some of the forms lately examined with the 4 mm. may be of interest. A very large central solid cone has been invariably employed in conjunction with either Gifford's or the beautiful new acetate of copper screen.

Nitzschia curvula Sm. This diatom is mounted next to *Amphipleura pellucida* on Moller's dry "Probe-platte." Transverse striæ close and delicate, but undoubtedly resolved.

Nitzschia sigmatella Grun. Moller's balsam type slide. Transverse striæ extremely faint and difficult. A delicate object even with N.A. 1·3 and 1·4.

Nitzschia linearis and *N. obtusa* Sm. In balsam. The former very faintly resolved into transverse striæ,the latter not so difficult. Dr. H. Van Heurck, in his "Synopsis des Diatomees," gives *N. linearis* as having 27 to 30 striæ in 0·01 mm. (25.399 mm. = 1 inch), and *N. obtuse* 26 to 27 in 0·01 mm. *N. sigmatella* Grun., is given at 25 to 26 striæ in 0·01 mm., but the specimen of this form on the type slide has much finer structure than *N. linearis* and *N. obtusa.*

Nitzschia sigmoidea Sm. Moller's dry "Probe-platte"—25½ to 26 striæ in 0·01 mm. according to Van Heurck. This is remarkably easy with the 4 mm., the striæ presenting a beaded appearance. They can be certainly seen with the 12 mm. apochromat of N.A. ·65, so do not probably, in this instance, exceed 55,000 to the inch. A specimen in balsam is also very easy with the 4 mm.

Nitzschia sigma Sm. Van Heurck gives 22 striæ in 0.01 mm. Distinctly dotted in balsam, and very easy in mixed monobromide of naphthaline and balsam.

Grammatophora oceanica Ehrenburg. = *G. subtilissima.* Moller's dry "Probe-platte." Resolved into transverse striæ. Van Heurck gives 30 striæ in 1·01 mm. for the *G. oceanica* var. *indica* Grun., and 30 to 31 for the *G. oceanica* var. *novaezeelandiae* Grun. Some specimens of *G. subtilissima*, however, are finer, running at about 88,000 to the inch.

Navicula crassinervis. Striæ 34 to 35 in 0·01 mm. according to Van Heurck. This has proved a most delicate object with the 4 mm., both dry and in realgar. With N. A. 1·3 and 1·4 realgar mounted valves are sharply resolved into dots, but the transverse striæ have alone been seen with the dry lens.

Hyalodiscus subtilis. In a mixture of monobromide of naphthaline and balsam. Dotted structure on outer zone well seen, although faint and difficult near the edge of the disc. In balsam mounts the structure appears still fainter, but nevertheless may be traced nearly to the outer edge, where it runs at about 76,000 to the inch.

Surirella gemma Ehrbg. In realgar the beading has been seen beautifully defined with the valve arranged longitudinally on the sharply focussed edge of the lamp flame. Specimens mounted dry, in balsam, and in quinidine, have been also examined, but their complete resolution has proved a much more difficult matter.

Colletonema vulgare. Moller's balsam type slide. This has been most carefully studied with the 4 mm. The resolution is very faint, and requires particularly exact focal adjustment, but when once seen it can be held fairly steadily without any great difficulty. Dr. Van Heurck writes of this diatom, "Stries fines, délicates, les moyennes faiblement radiantes, les terminales parallèles, environ 34 en 1 c.d.m.; les stries médianes plus fortes, plus écartées, 24 en 1 c.d.m. et plus radiantes."

Navicula major. Moller's balsam type slide. The full resolution of the structure of the bands on the hoop of this diatom is by no means easy, even with the Zeiss 3 mm. apochromat of N.A. 1·4. Notwithstanding this, the resolution is carried very far by the 4 mm., the striæ appearing remarkably black, crisply defined, and well separated, their beaded nature being quite recognizable, although not so fully revealed as with the oil-immersion. On this specimen the striæ alone are just visibly separated by the 12 mm. apochromat, 5-6ths axial cone, and a Huyghenian eyepiece magnifying about 45 times, the 27 compensating ocular not proving sufficiently powerful for the purpose with this objective.

COMMENTS BY DR. E. J. SPITTA.—To enable an object consisting of lines separated by minute intervals, or dots, or any small structures, to be seen, two conditions were absolutely necessary. First, that such objects should be sufficiently magnified for the eye to be capable of seeing them; and secondly, that the N.A. of the objective should be high enough to render such objects sufficiently resolved; for every one in the room was familiar with the fact that mere magnification without sufficient N.A., or "empty magnification," as Professor Abbe called it, was as useless as N.A, without the proper amount of magnification.

Now with regard to the first condition. It was supposed thas 1-250 inch represented the minimum distance that two objects, whether lines or dots, must be separated for the normal human eye to see and separate them distinctly at a distance of ten inches. No lines or dots closer than this could be recognized in their individuality. In other words, no matter what might be the real distance between any two dots or lines on a diatom they must, by optical means, be so rendered to the eye, when looking down the microscope, that they did not appear closer together than 1-250 of an inch. It was more convenient for them to be magnified a little more, so as to be separated apparently by a greater interval, because in that case those whose eyes were not absolutely normal would see them better; but anyhow they must not apparently be separated by an interval of less than 1-250 of an inch. The lines on *Amphipleura pellucida* were mostly about 100,000 to the inch, so to see them with the microscope the entire optical arrangement must result in magnifying at least 400 diameters, because $400 \times 250 = 100,000$. Now, how did the author obtain his magnification, and what was it? He used a ⅛ in. objective and a 27 eyepiece. Well, that equalled a magnification of 1620, because the initial magnifying power of a ⅛ in. was about 60, and $60 \times 27 = 1620$. He had, therefore, plenty of magnification. But what about the N.A.—the second condition?

Abbe's law which was based on mathematical considerations admiting of no controversy, declared that, with the smallest possible beam of truly axial illumination, the number of lines to the inch capable of being resolved = $x \times$ N. A. where x is the number of wave-lengths to the inch of the light actually used. Putting this into actual figures, seeing that there are about 47,500 × ·95 gave 45,125 lines to the inch as the theoretical limit—a long way off 100,000. In other words, the lines must not be closer than 1-45125 of an inch. But with oblique light this formula was doubled, and became $2x \cdot 95$, or 90,250 to the inch, or 1-90250 of an inch apart. It was evident, then, that Mr. Merlin could not have seen lines 1-100000 or even 1-90000 of an inch, apart without oblique light, using only a 5-6ths cone of axial illumination; and this justifies the original remark that his specimen must have been a coarsely marked one. It was theoretically possible that the author might possess a photographic eye, so to speak: one that received impressions in the violet-blue ray as well as ordinary individuals did in the yellow-green or so-called "visual ray," but he had never heard of such a case.

As the formula already given applied to any ray, it should be possible to photograph on a plate what cannot be seen with the eye. The 100,000 lines to the inch could only be seen most faintly with the ·95 objective, but inasmuch as the wave-length of *photographic* light was about 1-62500 of an inch, twice that × ·95 gave a photographic limit of a little over 100,000 lines to the inch. His son, and himself had tried to do this. As they could focus the lines on the ground glass screen of the camera, they had to make trial and error exposures, and failed several times, but at last succeeded in just showing the lines.

Seeing things with a direct solid cone was no doubt very much better and more to be relied upon than seeing them by oblique light. An object with large markings well seen by direct light appeared simply gray with oblique light. If the lens employed was a fine one and the lines were very fine they could be seen with oblique light, but if they were coarse they were lost sight of by virtue of their largeness.

COMMENTS BY E. M. NELSON.—Mr. Merlin used the telescope, till his eyesight was exceptionally keen, which was probably as good if not better training for the eye than the microscope. The fact of one being unable to see any particular structure described in this paper would not, therefore, be evidence that Mr. Merlin was likely to have been mistaken in what he had seen. He had tried a 5-6th cone with the dry 4 mm. apochromat of ·95 N.A. with the ½-inch wick of a paraffin lamp and an acetate of copper filter, but was not able to effect resolutions to anything like the extent Mr. Merlin had done. He next tried sunlight with a heliostat, but the heliostat proved untrustworthy and the sunlight fickle, so he was not able to push his experiments as far as he would have liked. He found, however, that with sunlight he could use a filter of much greater thickness, and then he was able to see some of the structures. There was another point—viz., that the Abbe diffraction theory did not fit in with all the observed phenomena bearing upon that branch of microscopy. It was highly probable that the large solid axial cone had a greater resolving power in it than was generally supposed. His experience showed him that 80,000 times the N.A. of the objective was the resolving limit in inches with this kind of illumination, but from what Mr. Merlin had said it was evident that a larger coefficient must be employed. The little beads in the lines on the hoop of a *Pinnularia major* were, so far as he knew, unresolvable by oblique light, but with the 5-6ths solid axial cone he had been able to see them with the dry 4 mm. apochromat. Strange to say, this same object had in 1895 been a kind of minimum visible or crucial test for an apo. ⅛″ of 1·43 N.A. It appeared, therefore, that the "minimum visible," the "crucial test," the "scarcely resolvable detail" of one year became the commonplace object at a subsequent period. This, Mr. Nelson said, had been his frequent experience during the quarter of a century he had been actively engaged in microscopical work.

Does Rabies Originate Spontaneously?

D. E. SALMON, D. V. M.

Most of the older writers on rabies, those whose writings appeared before 1865, admitted that the disease might develop spontaneously in the bodies of certain animals as a result of certain conditions of life and atmospheric influences. These same writers believed that most other contagious diseases frequently originated in the same manner. It was a time when the spontaneous generation of many living things was frequently admitted, and when the ignorance of the nature of all kinds of contagion, with the exception of the larger animal parasites, was complete and impenetrable. Science had not yet definitely passed upon the doctrine of the spontaneous and continuous generation of living matter.

It was not a very long time before this when it was believed that the mite which causes scabies or itch was continuously developed spontaneously, and that it was folly for people to try to protect themselves from this disease. About the same time, or possibly a little earlier, at was thought that lice were spontaneously developed, and that both the domesticated animals and mankind were doomed to suffer from them for all time. Still earlier there was a common belief that crocodiles and other animal life developed spontaneously from the mud of the rivers and lakes in which they were found.

The study of natural history and the progress of science disproved one by one these ancient beliefs, and made it clear that all animals developed from pre-existing animals of the same kind. Even lice and the mites of scabies were found to be subject to this invariable law of nature, and the eradication of such pests was taken up with energy and perseverance. The rarity with which these parasitic pests are encountered among civilized people of the present day proves the value of correct views upon such questions.

The last point to be yielded by the believers in spontaneous generation was the origin of the protozoa and bacteria, microscopic animals and plants so small that their life history could be studied only with great difficulty. It was finally shown, however, that even these infinitely small organisms obeyed the general law of nature and propagated and developed from ancestors, each species after its kind, and that in the absence of ancestors not even these low forms of life could appear.

About this time it began to be suspected that the cause of the contagious fevers was microscopic organisms, which were able to live a parasitic life in the bodies of men and the larger animals. After many observations pointing in that direction it was finally demonstrated in 1876 that the cause of anthrax was a bacillus, and shortly afterwards that fowl cholera, septicæmia, hog cholera, tetanus, blackleg, tuberculosis, and various other diseases were due to similar microscopic vegetable organisms, each disease being caused by its own distinct species of germs. It was also shown that malaria, Texas fever, and some other diseases were caused by microscopic animal organisms belonging to the protozoa, and that here again each disease had its own definite and distinct species. In every case the minute plant or animal parasite had its own definite form and certain biological characters by which it might be distinguished from all other living things. Each species multiplies and propagates its kind, and there is no more evidence here than elsewhere in nature to sustain a doctrine of the spontaneous appearance of living things.

The first effect of these scientific demonstrations was to clear away a vast amount of rubbish which had accumulated in the standard teachings as to the cause of contageous diseases. If, for example, anthrax is caused by the *Bacillus anthracis* gaining entrance to the interior of the body and multiplying there, and if the disease cannot be produced in the absence of this bacillus, then it becomes plain that the disease is not caused by electrical disturbances of the atmosphere, by too much food or too little food, by forage containing too much water or that which is too dry, by intense heat of summers or extreme cold of winters, or indeed by any of the other influences to which the development of the disease has been usually attributed. It was contact with substances containing the bacillus which produced the disease, and when this bacillus gained access to the animal body the disease developed without reference to the atmospheric conditions, the food, or the other elements of the environment.

The comprehension of this fact led Bouley and other great pathologists to revise their opinions regarding the origin of many contagious diseases. It had been held that glanders originated spontaneously from overwork and insufficient food; that bovine pleuropneumonia developed as a result of exposure of cattle in the mountains of Europe to extremely low temperatures; that cattle plague arose spontaneously in eastern Europe, and particularly on the steppes of Russia, and that rabies in the dog resulted from unfavorable conditions of life. The demonstration of the germ theory of contagion, which was quite unexpected by the majority of medical men, completely overturned these old views, based upon an entirely different hypothesis. The idea of spontaneous development, of origin *de nova,* was generally abandoned, and the further scientific researches have been pushed, the more incontestible does it appear that the one and only factor of consequence in the production of these diseases is the entrance of the disease germ into the interior of the animal body, where it can multiply and disseminate itself.

If proper measures are taken to protect animals from the bacilli of anthrax, of glanders, of pleuropneumonia, they do not contract these diseases. Investigation of cattle plague in central Europe indicated that the disease always came from the East. Investigations on the steppes of Russia showed that it did not originate there, but came from the plains of Asia. Investigations in Asia indicate that even there the disease is always the result of contagion from some other affected animal. In the same manner, investigations of rabies failed to bring out any evidence to indicate that the disease might originate in any way except by contagion, that is by inoculation from an affected animal. It may, therefore, be accepted as practically certain that rabies does not develop spontaneously in any animal, but that it is always the result of inoculation from some other affected animal.

If the doctrine of spontaneous generation, or abiogenesis, has been abandoned by scientific men, it has by no means lost caste with many persons who consider themselves philosophers ; and these persons hesitate to accept or indeed bitterly contest the conclusion of science,which has been outlined above. If, they ask, every dog with rabies contracted the disease from some other dog affected with it, how did the first dog get it ? This is a question as to the origin of things, which we may with equal reason ask in regard to all living organisms. If every dog is brought into the world by the sexual union of the two other dogs, where did the first dog come from ? This question is just as difficult, but no more difficult than the other. Because we have in our question implied the philosophical absurdity of a series of dogs without a beginning, we have not convinced anyone that dogs can originate in any manner except by ancestors of their own species, nor is the similar question as to the origin of the first case of rabies any better reason for accepting the theory of the spontaneous origin of this disease.

There are many diseases of which it may be said that in our time and in our country they arise only by contagion. Prominent among these are smallpox, scarlet fever, measles, cholera, tuberculosis, glanders, bovine pleuropneumonia, foot-and-mouth disease, and rabies. Recorded history does not tell us where and under what circumstances the first case of any of these diseases appeared, any more than it tells us where and under what circumstances the first dog appeared. We know by observation, and by observation alone, how dogs are propagated at the present day, and we accept observation as conclusive upon this point. Why should we not accept observation and experimentation as conclusive in regard to the propagation of a contagious disease?

While we can not resonably expect at this late day to decide the cause of contagious diseases by speculation as to the first appearance among animals of such diseases, it is legitimate to make such an inquiry in order to obtain a better understanding of these plagues. Science has made great progress in explaining the origin of species, and even in tracing in general terms the development of life upon earth; and while it can not say definitely where, when, and how the dog originated, it has been made plain that in some prehistoric age the dog developed from some earlier and related animal form, not by a sudden transformation, but by gradual transition. And in the same manner this early ancestor of the dog developed from a still earlier ancestor, doubtless quite different from the dog as he is to-day. To be brief, in tracing the development of the dog, we should be obliged to go back, step by step, toward the dawn of creation, toward simpler and simpler forms of life, until the primordial germ is reached. Just where in this long series of succeeding forms or just when in the countless ages that have elapsed since the beginning of the series the disease known as rabies appeared it it impossible to say. It may have been in comparatively recent times, and when the dog had arrived at substantially its present form and development, or it may have been in some previous geologic age, when the conditions of environment upon all parts of the earth were far different from what they are at the present day.

It is not to be supposed that the strange animals whose fossil remains prove their existence many thousand years ago were free from contagious diseases any more than are the animals which live to-day; but whether the diseases of the prehistoric animal species were propagated from animal to animal until our time, or whether they disappeared and were replaced by more recent plagues, it is now impossible to say.

A study of the communicable diseases indicates that most if not all of them are caused by parasitic organisms. Indeed, the animal body has become the host of a multitude of parasites, most astonishing because of the number of species and the great variety of forms. All of these parasites probably at one time in the existence of their species, or of the ancestors of their species, lived elsewhere in nature. Under certain conditions they were attracted to certain kinds of animals; they found they could live upon or within them; they adapted themselves to these new conditions; their form and their physiological requirements were gradually changed, until finally in the course of time they could not exist elsewhere. They were then strictly parasitic.

So far has this development and adaptation to the conditions of environment gone that we find different species and varieties of lice, of mites, and of worms living upon each different species of animals, and in most cases these parasites perish if transferred from one species of animals to another species. If, therefore, these parasites can not exist when transferred to a different species of animals from that upon which they have developed and to which they have become adapted, there is all the more reason why they can not exist in nature elsewhere than upon or within the animal body. Hence, we find animal species living as parasites upon other animals, and having no individuals of their species living a non-parasitic existence. They have developed and have been modified since they began their existence as parasites, just as the species of animals living free in nature have been modified. Consequently, if an animal becomes infected with lice or mites at the present day it must get them from some other animal which bears them.

The adaptation and modification of the bacteria and protozoa which cause the contagious diseases has probably occurred in much the same manner as that of the larger animal parasites which we have been considering. The glanders bacillus has lived a parasitic existence in the bodies of animals of the horse kind for many thousand years. It is no longer able to multiply or live for any considerable time in nature outside of the animal body. It is therefore a strictly parasitic organism. The bacilus of tuberculosis is even further developed as a parasite than the bacillus of glanders, as it is much more difficult to cultivate in the laboratory even under the most carefully adjusted conditions. There is no reason to suppose that any bacilli exist in nature having the same biological characteristics as have the glanders and tuberculosis bacilli.

The exact form of the rabies virus has never been satisfactorily determined, but what we know of it leads to the conclusion that it is a parasitic organism of some kind, which has been modified by thousands of years of existence within the animal body, and which has no counterpart elsewhere in nature. Inoculation with it is easy; it has specialized as to the conditions of life to such an extent that it multiplies only in the brain, spinal cord, nerve trunks, and a few glands; it can not be made to grow outside of the body by any methods now known. All these facts indicate an obligatory parasitic existence. When or under what conditions in the prehistoric ages of the past it first became parasitic can never be known, nor can we determine at this late day how long a time was required to transform it from an organism which was only occasionally or accidentally parasitic into one which could live no other but a parasitic life. What appears certain is that for more than two thousand years rabies has been the same disease it is to-day ; that it has been propagated by the same species of animals, manifested itself by the same symptoms, and produced the same fatal results.

It is not likely that other microscopic organisms will from time to time take up their habitat in the animal body and become obligatory parasites. There are a number of different bacilli now known which are capable of living in the flesh and causing fatal disease, but which only do this under accidental conditions. Among these are the anthrax bacillus, the bacillus of blackleg, the bacillus of malignant œdema, and the bacillus of tetanus, all of which are deadly in their effects on animals inoculated with them, but all of which lack some quality required for their rapid dissemination or for the ready infection of susceptible animals. Consequently, they do not usually spread from animal to animal. With slight modification the anthrax bacillus might become the most terrible of the known disease germs. But that such modifications require time and conditions not often found, is proved by the fact that though this disease has been known since the beginning of medical knowledge, the bacillus has in the memory of man made no progress as a disease-producing organism, but on the contrary appears less capable to-day of gaining entrance to the tissues than it was two or three centuries ago.—*Ag. Depart. Year Book*, 1900.

Terminology of the Study of Blood Normal, and Abnormal.

HARRY D. OBERT, M. D.

The blood consists of a liquid basis or plasma, in which are found two great varieties of cells, the red and white. The red ones are termed erythrocytes and the white ones leucocytes. The red cells are bi-concave discs, dark at the edge and with a clear or bright spot in the centre due to their bi-concavity. When this spot shows very distinctly a pathological state exists which we term endo-globular degeneration. There is no nucleus in the red cells. The white ones are nucleated in various manners, according to their stage of development. In addition to the corpuscles, there exists the so-called blood plates. Blood plasma when obtained free from corpuscles is perfectly colorless in thin layers. The red color of the blood is not due therefore to the blood plasma, but is caused by the mass of corpuscles held in suspension.

The blood leucocytes which are by far the most interesting part of the blood to study, are divided up in different classes, depending upon their stage of development. The function of these leucocytes has been the subject of numerous investigations, particularly in connection with blood diseases, but it cannot be said that we possess any positive information as to the normal function of these cells. These cells are not all the same, histologically. Erlich's classification divides them into three groups ; (1) Oxyphiles or Eosinophiles, or those which stain with an acid aniline dye, the acid portion of the dye acting as the stain. (2) Basophiles, those staining with a basic dye. (3) Neutrophiles, those staining with a neutral dye. These white cells are nucleated, with one, two or more nuclei which change their type and may become the so called transitional, the terms then, being mono-nuclear transitional and poly-nuclear. Normally the reaction of the blood is alkaline owing mainly to the alkaline salts and especially the carbonates of soda, which are dissolved in the plasma.

The specific gravity of human blood in the adult male may vary from 1,041, to 1,067. The number of red blood cells is about 5,000,000 to the cubic millimeter of blood in a healthy adult male, and about 4,500,000 in the healthy female. If this number is exceeded which is very rare, the condition is called Polycythemia ; if decreased it is termed, Oligocythemia. One of the most marked instances of the former which occurs , is the very extraordinary increase of red cells which is often met with in cases of congenital cardiac disease in children, amounting to as many as 8,000,000 to the cubic millimeter. A similar increase is seen in Phosphorous poisoning. Beside the ordinary red blood cells, we find in health small red cells supposed to be immature red cells, and called microcytes, while we may at times find very large red cells or Megalocytes. Not only may the red blood cells change but the quantity of their hæmoglobin may also vary. Normal blood should contain 100 per cent, although we may have perfect health with the amount estimated at 85 per cent. This decrease is termed Oligochromaemia. In disease we find more or less marked alternation in the red cells themselves and in their coloring matter. The microcytes and the megalocytes already mentioned may become greatly increased in number. The red cells when they become deformed are termed Poikilocytes. Some red cells, which unlike ordinary red cells possess a nucleus and are capable of amœboid movement are usually given the very confusing name of Normo-blasts. Other cells have been found that contained pigment, or are vacuolized, or again so dim in appearance that they are called shadow corpuscles. The proportion of the white to the red cells in health is about 1 to 500, but a very great variation may occur. Thus after meals the white corpuscles are always increased so that the proportion may be 1 to 150. On the other hand, after this primary increase they may be decreased and the proportion may be 1 to 800. Time of day is also a factor in producing variation.

The instruments employed to-day for the examination of blood consist essentially of the microscope which is used to determine the quality and the character of the red and white cells, their comparative number and the presence of parasites; the polariscope which is employed in the color test for the purpose of determining the proportion of haemoglobin or in other words, the ability of the corpuscles to carry oxygen to the tissues, or for example,to detect the presence of carbon, mon-oxide-haemoglobin. Last but not less important is the so-called Thoma-Ziess haemocytometer, which is a very delicate instrument used to accurately estimate the number of corpuscles in the blood.

Anaemia, which means a deficiency in blood and is represented or portrayed by two conditions, in one of which the pallor and other symptoms are due to a diminution in the number of red corpuscles, while in the other there is a decrease of haemoglobin in each corpuscle. In regard to the white corpuscles, we can find even more interesting data, since their variation in number, form and character is marked in some diseases. Practically all conditions of the blood which are pathological, represent disease in organs connected with the blood directly or indirectly and do not depend upon primary changes in this liquid, except in rare instances. There are several varieties of anaemia, the most important of which is the so-called Pernicious Anaemia, in that it progressively gets worse until death occurs in the majority of cases, although a few may recover. The pathology of this disease is not understood. It is characterized by marked pallor without loss of flesh, or to speak more correctly, the sub-cutaneous tisues are added to rather than robbed of fat. There are gradually increasing dyspnoea, failure of strength, cardiac palpation, venous murmurs, some vertigo and tinnitis.

The blood shows a most extraordinary and continually diminishing number of red cells, until the number may amount to only 143,000 to the cubic millimeter. In addition the following points of great diagnostic importance are to be noted. First the individual red cell is richer than normal in Haemoglobin; second, many are larger than normal; third, the red corpuscles are deformed, some being ovoid, others irregular; fourth, there are present microcytes or small cells; fifth, there are nucleated red cells, and, sixth, we may find megalocytes and megaloblasts which have a plain staining nucleus. The megaloblasts are termed corpuscles of Erlich, since he claims that they are Pathognomonic of pernicious anaemia. Anaemia, depending upon lack of Haemoglobin in the corpuscles rather than a decrease in their actual number, is seen most typically in that condition termed Chlorosis. In this disease the corpuscular diminution is so slight that it may be totally ignored, but decrease in haemoglobin is very great.

In connection with anaemia, I may speak of Leukaemia which means a marked increase in white cells, more particularly the large mono-nuclear leucocytes. Pseudo-leukaemia or Hodgkins' disease must be differentiated from true leukaemia, by the blood examination, it being stated that in this malady there is usually but a slight decrease in red cells and no other marked changes.

The parasites of the blood occupy a vast field of study and are held accountable for the different fevers such as malaria, Tertian fever, Quartan fever and the so-called Aestivo-Autumnal fever. These parasites consist for a great part of the malarial germ of Laveran or the "Haematozoon Malariae," and the "Filaria Sanguinis Hominis." No more important addition to the study of disease from a diagnostic standpoint has been made than the discovery of the presence of a parasite in the blood of persons suffering from malaria fever, a parasite which is always present under these circumstances, and in all probability acts as the cause of all malarial phenomena. The parasites are varieties of sporozoa which live inside of the cell of the individual attacked. The parasite of malarial fever occurs in three forms, namely, as that of Tertian fever, that of Quartan fever and the parasite of the already mentioned Aestivo-Autumnal. A parasite of Tertian fever is a small Hyaline colorless body which occupies but a slight extent of the interior of the cell. When quiet, the parasite is round like the corpuscle but if examined fresh, it will be seen to have active Amœboid motion. By the terms Tertian and Quartan, we mean as for Tertiana fever which occurs every two days and for Quartan every three days. We may have a double Tertian or in other words, a Quotidian type in which the attack occurs daily. The cause of the paroxysm at a stated time is explained by the fact that when segmentation occurs in the full grown parasite we may look for an attack. The Quotidian fever is explained by the fact that two sets of parasites operate, one set segmenting say to-day, and the other to-morrow. The Quartan parasite which causes an attack every third day in its earlier stage of development, looks very much like that of Tertian form, for it occurs as a small Hyaline Amœboid body filling a fraction of the corpuscle. It soon, however, develops the following differences: first, it develops a sharper outline; second, it is more refractive; third, the Amœboid movement is slower; fourth, the pigment granules are coarser and more important, they lie very quietly around the edge of the parasite; fifth, the corpuscle acts as host and does not increase in size and finally disappears. In the third form of infection, the Aestivo-Autumnal, we find small Hyaline bodies. They have ringed appearance and are sometimes very small. Suddenly this body becomes larger and the ring is lost. Then however an Amœboid movement takes place and a true ring is formed. The Peripheral circulation in this disease contains very few parasites.

Filaria and by this term we mean a long slender worm-like body existing and swimming in the blood and lymphatics. The "Filaria sanguinis Hominis" occurs in three forms. First, the "Filaria Diurna" or that species existing by day. Second, the "Filaria Nocturna" or that which exists by night, and third, the "Filaria Perstans" or that one existing persistently at all times. The "Filaria Diurna" and the "Filaria Perstans" are confined to patients found on the west coast of Africa and adjoining districts, while the "Filaria Nocturna" is pandemic in the tropics, and endemic in certain sections of the United States. The Filaria Perstans has been practically proven to be the cause of the so-called fatal "sleeping sickness" of the Congo region.

Prognosis as determined by a blood examination in pneumonia shows in this disease as favorable if Leucocytosis is present, but is a bad sign if absent even in the mild cases and certainly points toward a fatal issue. Leucocytosis simply shows that the system is re-acting.

In diphtheria here again, the absence of Leucocytosis is a bad sign even in the mildest case. The phenomena should keep pace with the severity of the disease. The staining reaction is said to be proportional to the severity of the disease. Also, in scarlet fever and Scarlatinal nephritis, "Eosinophile" is the good sign and its absence a bad one. As in the before mentioned, the Leucocytosis is proportional to the severity. The foregoing facts simply serve to show that a conservative prognosis should not be made without a thorough blood examination.

The blood corpuscle first makes itself known in the marrow of long bones from whence it passes into those long narrow cylinders the blood vessels, where it must meet its foes, must fight disease, be overcome or return victorious.

BIOLOGICAL NOTES.

L. H. PAMMEL.

MYXOBACTERIA.—Since the publication of Dr. Thaxter's excellent account of Myxobacteria in 1892, several papers dealing with this interesting group of bacteria have been published. The species though mostly American have also been found in Europe and Liberia in Africa. Zukal has found four species of the genus Chondromyces in Vienna. C. Lorrain Smith in a recent number of the Journal of Botany describes a Myxococcus pyriformis found on the pellets of the rabbit dung. This organism produces pear-shaped cysts of a bright pinkish-orange-color on a short transparent gelatinous stalk. The cocci are round or somewhat oval. The colonies in culture tubes are colorless or dirty white consisting of motile rods. (Jour. Bot. 39 : 69-72, 1f).

NEMATODE GALLS ON MARINE ALGÆ.—Ethel S. Barton describes nematode galls found on Furcellaria fastigiata and Chrondus crispus. Thus far little attention has been given to the subject of gall formation in algæ. The galls form irregular knobs, due to the fact that they exceed or equal in size the diameter of the main stalk. The cells below and around the galls contained small granules which seem to correspond to Van Tieghem's Floridean starch which consists chiefly of Amylodextrin. (Jour. Bot. 39 : 49-51, Pl. 418, f. 1-6).

MUSHROOMS.—Much interest has in recent years been manifested in the study of mushrooms in this country, partly because of their undoubted food-value. Hamilton Gibson perhaps did as much as anyone else to popularize the subject. But several botanists have done much to bring the subject before the public in an intelligent way. Among the earlier writers mention may be made of Curtiss, of North Carolina. Of the more recent contributions the valuable papers by Farlow and Peck should be mentioned. George F. Atkinson's book on Mushrooms (Studies in American Fungi, Mushrooms edible, poisonous, etc) not only takes up the morphology, but the development and characters by which many species may be recognized. In this book of something over 200 pages the common species are described and illustrated. The pictures are as good as the photographer's art and engraver could make them, and the printer has done his part well. The photographs in many cases show the natural habitat of the fungus. The spore prints and sectional views given show the structure at a glance. Notes on distribution, and whether poisonous or edible accompany the description so far as known to the writer. A good key to North America genera of the family Agaricaceæ and a key for families accompanies the volume, as well as a glossary of the more technical terms used in the work. Mr. Hasselburg furnished the matter applied to certain structural characters of mushrooms. The chapter on chemistry and toxicology was written by J. F. Clark. The recipes for cooking were furnished by Sarah Tyson Rorer. An excellent bulletin on mushrooms has also recently been issued by Prof. L. F. Henderson of the Idaho Agricultural Experiment Station.

EMBRYOLOGICAL STUDIES OF QUERCUS.—Very little work has been done in working out the life history of Quercus but Abram H. Conrad, has given us a good account of Quercus velutina. The material was quite refractory. Chromo-acetic and picro-acetic acid were the most satisfactory for fixing. Cyanin and Erythrosin proved good for early stages and Delafield's hæmatoxylin for the archesporial stage and fuchsin and iodine green for embryo sac and embryo. (Bot. Gazette, 29 : 408.)

SCLEROTINIA.—Prof. Ralph E. Smith, gives the results of his investigation on Botrytis and Sclerotinia, their relation to certain plant diseases and to each other. He comes to the conclusion that Sclerotinia libertiana and

Botrytis cinerea hava no connection whatsoever with each other and that the former species has no conidial stage of this type. It shows at all times a mycelium composed of large branching septate filaments, averaging from 10-15 microns in diameter. Sclerotia are always produced abundantly in cultures and affected plants. The sclerotia are sometimes an inch long. The Peziza form is readily produced. The fungus is a good example of a facultative parasite. It attacks a great variety of plants. (Bot. Gazette. 29 : 369.)

STUDIES IN MYXOMYCETES.—E. Jahn in some cytological studies of one of the Myxomycetes, Dictydium umbilicatum, obtained best results in fixing with Flemming. He succeeded in obtaining good nuclei by staining with Hæmatoxylin, Safranin and Gentian Violet. He did not succeed in obtaining karyokinetic figures. Chromatin threads and nucleolus can be made out very readily. The Dictydium granules described here have not heretofore been recognized in any other group of these organisms. Chemically they are differentiated because of their resistance to acids and alkalies. The chemical nature was not determined. They do not give the chemical reaction for cellulose, though they may prove to consist of substance related to cellulose. (Ber. d. Deutsch Bot. Gesellsch. 19:97.)

TUBER-LIKE BODIES OF CYCAS.—Mr. A. C. Life discusses the tuber-like rootlets of Cycas revoluta. The coral-like outgrowths have been known for a considerable length of time and there has been much discussing as to their nature. The author has made cultures of the tubercles on agar and from these he raised three different bacterial forms, an organism resembling the Rhizobium of Schneider being obtained. The fungi and bacteria which are in cells in advance of the alga zone seem to prepare the way for the algæ. The author says it is difficult to speak with any certainty with reference to the symbiotic relations which exist between these various organisms. It has been suggested for certain plants that the converting of free nitrogen and simple nitrogen compounds into the more complex forms used by the plant is due to the nostoc. And the writer suggests the possibility of the use of nostoc forms in the cycads in the assistance of nitrogen assimilation. The tubercles then, have two functions, that of aerating, and that of assisting in nitrogen assimilation. (Bot. Gaz. 31; 265.)

MICROSCOPICAL MANIPULATION.

NEW METHOD OF EXAMINING SPUTUM.—Lanuoise and Girard (Arch. gen. de Med.) recommended the following method of examining sputum suspected of containing tubercle bacilli. It is based on the property possessed by the alkaline hypochlorites of dissolving mucous matter without the aid of heat. The sputum is put into a conical vessel, and covered by about 10 times its volume of a 33 per cent solution of chlorinated soda, and the whole well stirred up. It is then set aside for 24 hours, being given an energetic agitation from time to time. The disengagement of chlorine commences at once, and in 20 minutes globules of mucus and of pus (should the latter be present) are dissolved, the liquid becoming more or less turbid from the matters held in suspension. At the end of the time named, however, the suspended matter will have settled in the conical point and the supernatant clear liquid may be drawn off with a pipette. If a centrifugal separator is at hand, the operator can, of course, save himself the delay by operating on a single tube several times, decanting each time. When the volume of the material has been reduced to 2 or 3 c.c. there is added 5 or 6 drops of normal solution of sodium or potassium hydrate, (40 grams of $NaOH$ or 56 grams of KOH to the liter of water). This transforms the residual chlorine into a chloride of sodium or potassium, as the case may be.

The mixture is allowed to stand, and the supernatant decanted. This leaves the material in condition to be fixed and stained by the processes of Zeihl or Ehrlich.

THE MICROSCOPIC EXHIBIT OF THE N. Y. BOTANICAL GARDEN.—This unique exhibit, both conceived and presented by Mr. William E. Dodge, has been temporarily installed in the hall of the west wing, and at present consists of twenty-four microscopes of special design mounted, by pairs, on twelve specially built oak stands, costing $665.50. As this collection occupies a hall otherwise containing only cryptogams, it was decided to restrict the objects shown by the microscopes to specimens selected from the plants below the spermatophytes; thus the microscope exhibit enables a visitor to see the minute structure of the principal groups of the lower plants, from the myxomycetes or slime-moulds to the fern inclusive. Each microscope is accompanied by an explanatory label referring to the object shown by the instrument.

MEDICAL MICROSCOPY.

SARCOMA.—At the N. Y. Acadamy of Medicine, March 27th, Dr. Jonathan Wright said that the clinical history was entirely opposed to a diagnosis of melanotic sarcoma, as this was a specially malignant form of sarcoma. He had seen a number of apparent sarcomata of the septum in which, so far as the microscopical examination had gone, there had been nothing to distinguish them from malignant growths. In some of these cases the growth had been simply shaved off, and there had been no return. Where the clinical history contradicted the microscope in cases of suspected sarcomatous malignancy, he preferred to rely upon the clinical diagnosis.

SEA-WEEDS.—Tabulæ Phycologicæ by Fr. T. Kuetzing, in 19 vols. and index, has 1900 finely colored plates and sells for $500. A Leipzig book-seller, whose address we can give when requested by postal card, has undertaken to reprint volumes I-V, which alone are out of print, so as to sell complete sets for $125. provided a certain number of orders appear. Kuetzing's unique work is the greatest in existence on this subject and is indispensable for the study of sea-weeds. Our readers should seek to influence wealthy libraries in the U. S., to supply our country with at least a few copies,—especially the Boston Society of Natural History; the Astor Library, New York; the Congressional Library, Washington; the Lloyd Library, Cincinnati; the Chicago University; the Mechanics Institute Library, San Francisco; the Carnegie Library, Pittsburg; the Fish Commission, Washington, D. C., etc. We will receive the orders for it in America.

MICROSCOPICAL SOCIETIES.

QUEKETT MICROSCOPICAL CLUB.—The 387th meeting was held on Friday, May 17. Among the donations announced was one of 51 mounted specimens of Rotifers, presented by Mr. C. Rousselet, for which a special vote of thanks was passed. The collection of these organisms now in the club's cabinets amounts to 250, and, as type specimens, are invaluable for study. Mr. Massee gave a description of the life-history of several new fungi belonging to the Laboulbeniaceæ, recently discovered by Dr. Thaxter, U. S. A. They are mostly found growing on aquatic larvæ, chiefly coleopterous. The affinities of this group, especially in their reproductive organs, with the red algæ, was pointed out and illustrated by a number of colored diagrams. The meeting then resolved into the usual conversazione, at which several interesting living organisms were shown, including Stephanoceros, Vorticella, Volvox, and others.

The Club contains 340 members of whom A. M. Edwards, M. D., and Prof. H. L. Smith, of Hobart College, are Honorary; S. W. Fletcher, M. D., Pepperill, Mass., and D. Bryce Scott of Moncton, N. B are Ordinary.

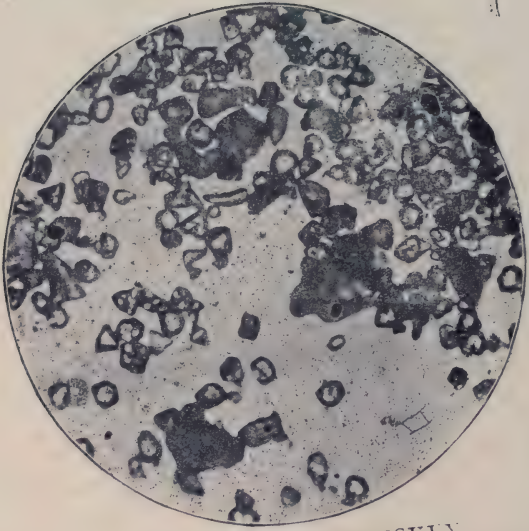
NEW PUBLICATIONS.

Das Mikroskop in Chemischen Laboratorium. By Dr. F. Rinne, 74 pp. 202 figs. 4 marks. Hanover. Optical properties of crystals and minerological microscopy get excellent treatment. Polarization and micro-methods are described in the German language.

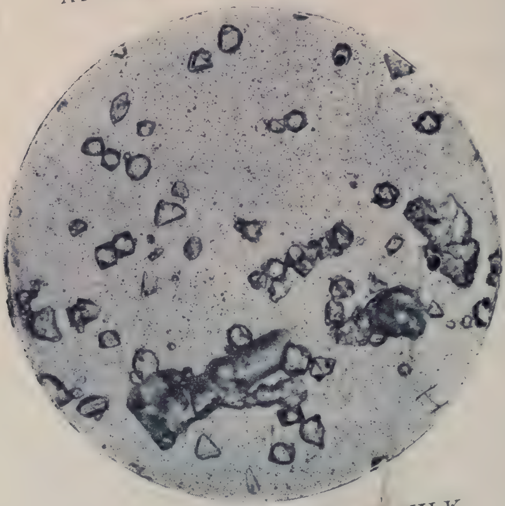
Die Technik des Modernen Mikroskopes. By Dr. W. Kaiser, 80 pp. in each of two parts, 4 marks. Vienna. Instruments of German and Austrian makers are fully discussed. Optics and mechanics in these two parts are to be followed later by other topics. Great advances have been made by Viennese firms of Reichert, Merker and Ebeling since 1880.

Strasberger's Botany. Fifth Edition translated by Hillhouse, issued in London, 1900, 519 pp. 162 figs.

An Astrology.—By A. Alpheus. 217 pp. 12 mo. Until within a century or two, physicians always used astrology and they used it more than all other people but astronomers used it also. The great Kepler used it and was nonplussed because he failed in an attempt to predict the death of Wallenstein. The position of Uranus is now said to have caused it, but Uranus had not been discovered in Kepler's time and had to be left out of his calculations. One of the most eminent physicians of Boston secretely uses astrology and told this author during the first hour of acquaintance that this author, then totally ignorant of the subject, that he would become a leader in astrology. This book in small compass, opens the whole subject, is beautifully bound and will be sent with the Microscopical Journal of 1901 for two dollars. You cannot afford in ignorance to ignore the matter.



ARSENIC FROM WHISKEY



ARSENIC FROM MALT MILK.

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Comparison of Samples of White Arsenic.

EDWARD BARTOW.

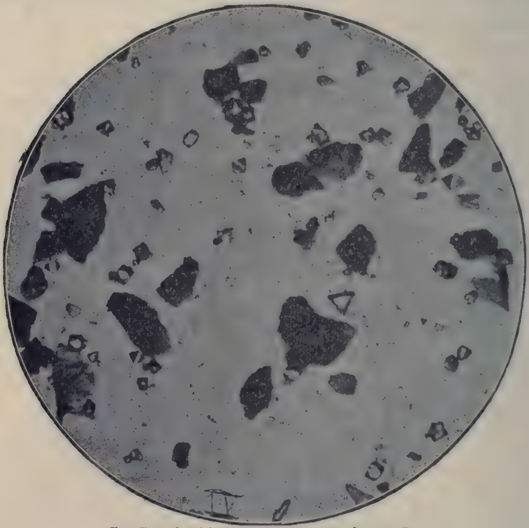
With Frontispiece.

In a recent case of suspected poisoning in this state, a bottle of malted milk was brought to me for examination. I found evidence of the presence of arsenic by the Marsh test, and by the Reinsch test; and even the simple test of heating the substance with a piece of charcoal, in a glass tube closed at one end, gave a heavy arsenic mirror.

Considering the greasy nature of the material under examination, I conceived the idea of separating the crystals of white arsenic, if the arsenic should be present in that form, by means of ether. On panning the malted milk with ether in a shallow porcelain dish, I was enabled to separate quantities of the crystals in a pure state. An attempt to do this with water failed. In fact, water could not be used on them until they were free from the fat.

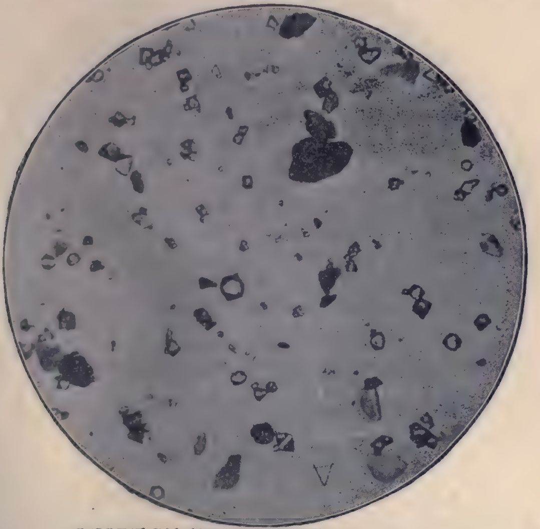
A few crystals of white arsenic were separated from a bottle of whiskey found on the premises of the deceased.

In following up a clue that seemed to point to the source from which the poison might have been obtained, the county attorney submitted to me a sample of white arsenic crystals obtained from this source. He requested me to determine whether they were like those found in the malted milk or in the whiskey. To my knowledge, the only work of such a nature is that of Professor E. S. Dana. Professor Dana enters into an exhaustive account of the methods of preparing white arsenic, and of the possibilities of differences due to the variations of the conditions during the process. He also made microscopical examinations of many samples of commercial arsenic, and deduced the following conclusions: "The study of a large number of independent samples of commercial white arsenic confirms the conclusions based upon the observations


SUSPECTED SAMPLE. x 75.

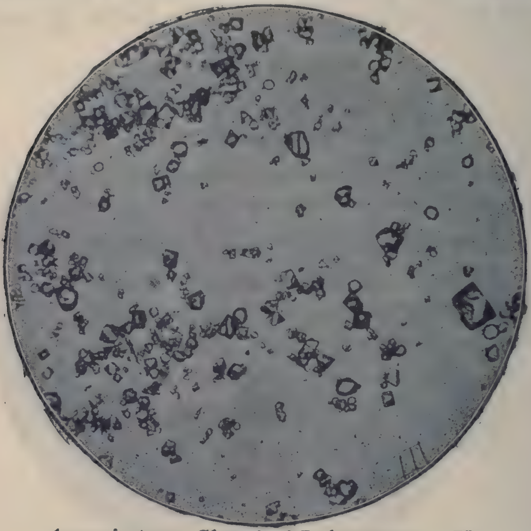
as to the method of manufacture, and shows that wide variations in character often exists. These differences, when they occur, are readily distinguishable by the microscope and, in most every case, it is, by this means, possible to conclude, of two test samples, whether they could or could not have come from the same source ; and this is true, under favorable conditions, even if one of the samples has been subjected, for some time, to the action of the stomach."

The work of Professor Dana is well known, but at first I had only at command the limited notice given to it in the works on toxicology. Later I received the article of Professor Dana, which he kindly sent me, and was interested in carrying out more in detail the methods of work which he describes. My method of work was as follows :



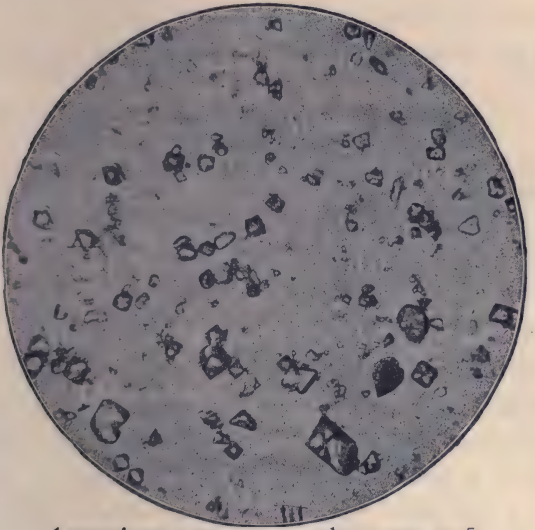
SUSPECTED SAMPLE No. 2. x 75.

I mounted a few slides of each of the samples (the limited amount of crystals separated from the whiskey made but one slide) as well as samples of white arsenic from the laboratories of the university and from the drug stores of the city. Differences were so marked that I at once concluded that the sample submitted by the county attorney and the arsenic from the malted milk could not have had the same source. To assure myself that the treatment with ether had not changed the character of the crystals from the malted milk, I mixed some of the arsenic from the suspected source with pure malted milk, using the same proportions as were found in the malted milk containing the poison, then panned out the arsenic in the same manner as from the original sample of malted milk. Several slides were made with the arsenic treated in this way. After the process there was no difference in the appearance of the sample.



Arsenic from Chemical Laboratory. x 75.

In the microscopical examination, I noted the size of the crystals, the size of the amorphous bodies present, the character of the amorphous bodies, and the relative number of crystals and amorphous bodies. We may thus summarize the observations of the crystals from the milk,the whiskey, and the suspected sample. The crystals from the suspected sample were the smallest, those from the whiskey were the largest, though not much larger than those from the malted milk. The amorphous bodies were of a similar size in each sample. In each case were some much larger than the crystalline bodies. Those from the milk were of a transparent nature, while the others were opaque. In the suspected sample, about 25 per cent were well shaped crystals. In the sample from the whiskey about 15 per cent were crystals. That from the malted milk showed about 40 per cent of crystals. From these differences I concluded that the arsenic in the suspected sample could not have had the same source as that found in the milk and the whiskey.



Amorphous arsenic from pharmacy. x 75.

In order to be sure that my separation of the various slides into groups was not due to my familiarity with them, I submitted these slides, together with slides prepared from arsenic from other sources, to Professor S. W. Williston, to Professor W. C. Stevens, and to Professor E. Haworth. Each had no difficulty in separating the slides submitted into groups, always putting those from the same source into the same group, and never classifying the suspected sample with the specimens from the milk and the whiskey, thus confirming my own conclusions.

All the comparisons were made directly from the slides, and, in fact, a better judgment can be formed by observing a considerable portion of each slide. I have, however, had a number of photo-micrographs made by Mr. F. E. Marcy the university photographer. These show the crystals magnified seventy-five diameters and give a very good illustration of the variations in the various samples. I have added also photographs of samples from specimens of white arsenic in the chemistry and pharmacy laboratories of the university, because they show a great variation in the percentage of crystals, though the particles are nearly of the same size.—*Kans. Univ. Quarterly.*

"Sketch of Thomas Henry Huxley."

By T. Chalmers Mitchell of London. 297 pp. 8 vo, 6 plates including portraits of Huxley, Darwin, Charles Lyell and Jos. Dalton Hooker.

Huxley was born May 4, 1825 and died June 29, 1895. From 17 to 20, he studied medicine and, in 1846, sailed on Her Majesty's Gun-ship, Rattlesnake for the Australian seas. Though only its surgeon, he became in reality its Naturalist and through the study of minute forms became at this early age a skilled microscopist. This book, therefore, appeals to every owner of an instrument. Besides, it is published by Putman's Sons in their best style at a fair price ($1.50). Huxley, at 60, told the boys in the Royal College of Science that when he was of their age he had to have his microscope lashed to the mast to get a glimpse of the forms that he was exhibiting to them in slides prepared at Naples. He said, however, that the difficulties of the past were often exaggerated, that with good light and a good lens together with the ship tolerably steady he never failed to get all the facts he sought, that the great thing was the good supply of specimens day after day because delicate oceanic forms deteriorated so rapidly. He did not mind the cramped quarters, the tiny cabin, the jostle of ship's crew, the absence of books, the lack of instruction or of learned companions. He had the sense to see and to rejoice in the advantages offered thereby. When Huxley cruised, the microtome was unknown. But tissues of animals too large to be examined or too opaque were either teased by needles which destroy the setting or were sliced by razors in a coarse manner. This was tedious and necessitated skill else considerable portions would be destroyed, misplaced or mutillated. But Huxley did more, be it known, through surmounting these obstacles than the army of highly pampered students of today who are provided with Minot's giant microtome, plus many accessories, by means of which tissues are embedded, hardened, cut to an incredible thinness and furnished in series of 100 or 500 sections. The study of forms has been revolutionized, and new methods require volumes for their obituaries since they pass away to make room for others. Our boys stuff their heads in college with the thoughts and methods of other men and all to little account. Huxley at 22, on the war vessel, did effective work which fools have said was due to genius though they have never told us the source of genius. Study and imitate Huxley, oh boy of poverty and of mediocrity, as portrayed by this writer rather than in the volumes from which he has segregated the data and you will see that latent genius is yours, that "self-reliance" is the father of genius and patient absorption its mother.

While Huxley had and genius possesses "self-reliance" it does not include self-esteem and self-indulgence. Self-reliance is an unconscious reliance upon a certain not-self within. Genius always alights upon the banner of that man. Huxley never accomplished anything with a homogeneous oil-immersion, one-tenth. His soul qualities did not require such a tool. An oil-immersion has NEVER enabled a man to get wisdom or a reputation from genius, since he would then rely on the lens and not on intuition. Huxley was driven, on the Rattlesnake, to rely on a something which I call intuition and which the world has called genius. Here is a lesson for every young microscopist and every naturalist who will study this volume.

Huxley became president of the Royal Microscopical Society but he never "fought lenses." The world will never know him as a microscopist, but the microscopists will always claim him. Of course, if he COULD have used modern lenses and appliances without the sacrifice of any advantage he possessed, his discoveries would have been far greater. For example, with all his study of Medusæ, he was never able to discover its nervous system which the highest powers now reveal.

We are told that Huxley was not in any sense of the word a collecting naturalist nor did the naming and classifying of species interest him. In such practices, lays the key to the insignificance of nearly all American college professors and the waste of time by all her students. Huxley wanted to examine "the architectural and engineering part of the business ; the working out of the wonderful unity of plan in thousands of diverse constructions, and the modifications of similar apparatuses to serve different ends."

Of Huxley's magnificent contributions to the up-rooting of theological dogma, this is not the place to speak and those interested are referred to Mitchell's sketch which is so sensible, so just and so free from abstruse technicalities that every boy of sixteen who takes kindly to Nature should be presented with a copy at the same time that he acquires a microscope. While Huxley was a prominent contributor to the Quarterly Journal of Microscopical Science he was a true philosopher. While he was not a churchman, he saw the Infinite Omnipresence in nature and adored it.

We are taking subscriptions to Kutzing's 19-volume work (1900 plates) on the Sea-weeds. Send for circular. C. W. S.

British Versus Continental Microscopes.

M. I. CROSS.

For accurate original research, where the worker has some understanding of the mechanical and optical means at his disposal, there is no microscope in the world to be compared with the best of those produced by the leading British houses. In them are to be found refinements of mechanical skill which, suitably employed, call forth a response from objectives and condensers which causes them to yield their very best effects. Even in the British models of medium size and modest cost there are to be found several that are but slightly less effective than the largest, and with which no Continental stand can vie.

Yet the British microscope plays but an insignificant part, numerically, in the world's supply. In laboratories and in places where microscopes are largely used, the Continental instrument holds sway and seems likely to maintain it, at any rate for the present. The question of price is not the factor in the existing state of things, for even in students' stands the British manufacturer keeps his rates at the competitive mark. Why then is it that he does not receive a larger share of appreciation and home support ?

The reasons usually given appear to be two in number, and are— (1). The British microscope exceeds the needs of the laboratory worker and student ; (2). The casing and general "fit up" is inferior. The first is distinctly a laboratory cry, and may be regarded as due to want of appreciation and education in matters microscopical. The second is more general in its application and in a lesser degree influential.

To do the largest amount of work in the least possible time with the most cut and dried materials is a spirit which pervades the present day, and it applies to microscopical as much as to other spheres of activity.

The laboratory worker wants as much done for him as possible, so that it may only be necessary for him to place his object on the stage and "spot" the structure. To get the best from lenses and condenser is not in his province. "Numerical aperture," "aplanatic cone," and "critical image" are, as a rule, vague terms to him. Hence it comes that an instrument that always has its substage condenser approximately focussed and centred, and the mirror fixed in the line of the optical axis, saves him time and bother and suits his methods of working.

No one can defend the use of what are in reality but rough and ready means of examination of structure, and no reliance can be placed on deductions made from such methods. We are among those who are sanguine enough tohope that in the no very distant future, the advantage of perfect control in manipulation, and a rigid tripod foot, as provided in the majority of British microscopes, will supersede the Continental model.

This can only be brought about by a demand for more thorough teaching of microscopical principles and manipulation, and if good work is to be done in English laboratories it should be seen to that those who use the instruments shall get the best possible out of them. If this necessity were recognized and taken up vigorously by the scientific world—and many know full well how much it is needed—a different state of things would in time prevail. We would not advocate the pandering to a low degree of appreciation by reducing either the calibre or working accuracies of the instrument. Let us all do our best to raise the users to a higher level.

Meanwhile, the British manufacturer has opportunities of making his instruments more acceptable in several ways, and especially in the casing and general "fit up."

A great improvement has taken place in recent years, but there is yet room for further effort. Generally speaking, British houses are inferior to their Continental rivals in this respect. It must be remembered that the horseshoe foot is more easily gripped and held firmly in its case than the tripod, but a strong and neat fitting for the latter ought not to be beyond the powers of the ingenious to contrive.

It may be fearlessly stated that a good day is coming yet for British microscopes if the makers do but set their houses in order, and in addition to providing the most sound and accurate instrument that can be, they give due consideration to every detail which will make them acceptable to those who are influenced by appearance. There is no disgrace in making a microscope and its case ornamental as well as useful.—*Knowledge.*

Microscopical Notes.

M. J. CROSS.

For *Knowledge.*

STAINING LIVING BACILLI.—We have had placed in our hands an interesting paper by Mons. A. Certes dealing with the selective coloring power of the spore-bearing filaments of the *living Spirobacillus gigas* with methylene blue, and the following is a brief *resume* of it.

He remarks that the experiments of Brandt, Henneguy and himself, dating from 1881, prove that living protoplasm can absorb certain aniline colors, but little has been done by biologists in the study of the action of coloring substances on living microbes. It has been found that certain microbes cease to live on being stained, others absorb the stain and still remain alive, while others do not absorb the stain either alive or dead.

The difficulty of making observations on selective coloration is obvious on such delicate subjects as bacteria, but M. Certes was fortunate in discovering the *Spirobacillus gigas* in the reservoirs at Aden; the length of these is usually 150-160 mikrons, but they are occasionally found 400 mikrons long.

These organisms placed in a weak solution of methylene blue continue to move about with the same activity as before, and the stained specimens can be preserved alive until the following day if care be taken not to exclude oxygen.

The effect of the stain varies according to the stage of development of the bacilli. During the first two or three days the living specimens are entirely and uniformly stained in blue exactly like dead specimens.

When the period of sporulation commences, alongside of the totally stained bacilli, the presence of bacilli of different shapes is observed,partially stained and much more clearly. In the same specimens are colored rings in juxtaposition to uncolored rings, grouped in the most varied manner and without any apparent fixed rule.

The spore-bearing individuals which appear a little after, give the clue to these selective coloration phenomena, which acquire a still greater clearness when the specimens are larger—as the turns of the spiral are less serrated, and the spore-bearing bacilli move more slowly in zig-zig fashion. One sees, therefore, that the spores, while refractive, have, except in rare cases, absorbed the coloring matter and that the filaments which carry them are, in general, more feebly colored, some times even uncolored, and that in those specimens whose spores are localized at one extremity on a fixed point on the filament, the rings which carry the spores are almost always uncolored.

Success largely depends on the coloring re-agents that are used. The finest quality of Ehrlich's blue and the chemically pure methylene blue of Grubler and Hochst in very weak solution are recommended, and they should be used at the precise moment when the first sporule-bearing individuals appear.

These phenomena are only visible in the living state; dead specimens stain so rapidly and uniformly that it is extremely difficult to obtain preparations in which the differentiated coloration is plainly or distinctly visible.

SUBSTAGE CONDENSERS.—It is gratifying to observe the number of first-class substage condensers that are offered by manufacturers, and it is a distinct indication of growing knowledge and appreciation of good things on the part of workers.

It was at one time an easy matter to make a choice when only two or three systems were available, but it is evidently presenting some complexity now, and in response to correspondents' enquiries we propose to give a few hints on the subject.

The main features of a condenser are: (1) *The achromatism*, (2) *aplanatism*, (3) *magnifying power*, and (4) *the size of the fixed lens.*

Achromatism and *aplanatism* can be considered togethes, but the latter is more important. Recognizing this, there is a tendency on the part of makers to claim greater aplanatism than is actually yielded; this can however, easily be verified by the methods described in the text-books. Achromatism is a desirable quality but we doubt the advantage of an apochromatic over an achromatic condenser; we would as readily work with the latter as the former provided the aplanatism were as well corrected, and this is frequently the case. Expense may therefore be avoided without loss of efficiency in this respect. The solid illuminating cone that an objective will bear has been frequently discussed. It is generally stated that three-fourths the full aperture is the best, but it will be found that the majority of lenses will not bear more than two-thirds without deteriorating in performance; there are some exceptional ones that will take more than a three-quarter cone, but this is not the rule, and a light filter is usually requisite.

The Power.—The magnifying power of the condenser should not exceed half that of the objective, less rather than more than half is always preferable. Many systems are arranged to work satisfactorily with the front lens removed, and by this means high and low power effects are secured in one combination.

Size of field lens.—The reason for the popularity of the Abbe illuminator, with its glaring imperfections, is on account of its large field lens and the ease with which it can be worked. A high power condenser must of necessity have comparatively small lenses, and requires as great care in manipulating as the objective itself. The Abbe achromatic condenser was an attempt to maintain the easy working of the Abbe illuminator in a corrected form, but it is really too heavy and clumsy and restricts the movements of a mechanical stage. The best condensers have, as a rule, the largest field lenses that can be advantageously fitted, but this point is deserving of special consideration when making a decision.

Recommendations.—From the foregoing it will be possible, with given objectives and a maker's catalogue, to choose the most suitable condensers. If a man proposes to restrict himself to low and medium powers, not exceeding say ⅛ in., he can readily make a choice, and we would like to specifically mention the new condenser introduced by Mr. C. Baker, of 244, High Holborn : in this a specially large field lens is provided ; the power (4-10in.) is exactly the right one for histologists and workers with medium power objectives, while the aplanatic aperture closely approaches .90. We have found it most effective in some work we have been doing recently, and great credit is due to the maker for its introduction.

The worker who does not go beyond an aperture of 1·25 can do all that his lens will permit with a dry condenser having the nominal aperture of 1.0 and yielding an aplanatic cone of ·90 as several of them do. If higher apertures are used, an oil immersion condenser is necessary. This advice has an appalling sound,but it is too little recognized that such systems can usually be worked dry,and will then give an aplanatic cone exceeding ·90. Such is the case with Watson & Son's holoscopic condenser. Again, the top lens can be removed and a condenser of low power secured. Oil immersion condensers are too little appreciated, and it will be found, if it is desired to work with medium and high powers, that the oil immersion system will serve every purpose and is practically a universal condenser.

ILLUMINATION WITH ARTIFICIAL LIGHT.—The lamp that has proved most universally satisfactory is the regular one sold for microscopical work, with a ½-inch or ⅝-inch wick, but to many people this is objectionable for several reasons, the chief of which is that with the general use of gas and electric light, a mineral oil is not kept in the house, excepting for this special lamp; it also is not clean to handle, and requires a certain amount of attention; also it is not always immediately ready for service when required. In laboratories, such a lamp is out of the question, and bare gas jets, or gas jets with upright chimneys, are generally to be found.

I have recently been making some experiments with gas and electric lamps to see if some practical form of illuminant, always available for use without special preparation, cannot be devised for critical microscopical work.

Two important considerations have to be kept in view, one is that the light must be brilliant, and the other is that it should be possible to focus an image of the source of light by means of the substage condenser, in the field of view.

A very serviceable illumination can be secured with the Welsbach incandescent gas light, but the reticulations of the mantle are an obvious objection, and the flame has too large a surface. These can be overcome by means of a shade of metal surrounding the chimney at a distance of three or four inches. In this shade,a small rectangular or circular slot should be perforated. When working, this slot would be treated as the source of light and focussed accordingly.

At a recent meeting of the Royal Microscopical Society, Mr. Rousselet exhibited an incandescent electric lamp of the Edison and Swan "Focus" type, which has a somewhat coarse filament not unlike a corkscrew suspended horizontally in the bulb. This lamp gives an intensely brilliant light, and it has on many occasions been used for magic lantern purposes. It was recommended that the light for microscopical work should be taken from the edge of the filament and focussed in the same manner as the wick of an oil lamp. The light arranged in this way was, however, to my mind too much diffused, notwithstanding that a shade was used. On making further inquiry I find that a stand for an electric lamp is made for laryngological and aural examinations which has joints and movements for adjusting in any desired position. In the usual type it carries an ordinary eight or sixteen candle-power lamp, but it will quite well carry the "Focus" pattern. If now an enclosing shade be provided similar to that described for the Welsbach light above, with an aperture which can be treated as the source of illumination, an ideal electric light for microscopy is secured. This would answer well also for photo-micrography.

A lamp, somewhat similar to the foregoing, has been used by me with considerable satisfaction, though long usage has created a distinct prejudice in favor of the ½-in. wick oil lamp.

All workers have not electric current available so this will not appeal to them, but the majority have gas, and where oil lamps are objected to, I would advise a trial of the Welsbach light arranged as described above.

PHOTO-MICROGRAPHY WITH ARC LAMP.—Trouble is invariably experienced in maintaining the light in one central position, and several devices have been resorted to in order to control this. No automatic lamp is really useful for the purpose. A hand-fed lamp must be employed. When this is properly adjusted and the condensing lens is in position, a luminous disc will be seen upon the leaves of the partially closed Iris diaphragm of the substage condenser. During an exposure it will only be necessary to maintain this disc in a fixed position by turning the milled head of the lamp very gently as required, and the light may be kept perfectly central for any length of time. It is presumed that a horizontal camera would be used.

STAINING FLAGELLA.—The preparation of Bacteria so as to exhibit flagella has always seemed to be unsatisfactory and difficult. Very few workers are really successful and none have produced permanent mounts. An interesting note occurs in the Thompson Yates Laboratories Report, by Dr. MacConkey, which deserves consideration.

It has been considered essential when staining such preparations to use a mordant, presumably to fix the dye in the substance of the flagellum. It is suggested that the rendering visible of the flagella in consequence of the use of the mordant is not because of the effect which it has hitherto been credited with producing, so much as by causing the flagellum to swell and become thicker. The flagella are of exquisite tenuity, so much so, that when stained, the dyes do not seem to render them visible to the same extent as when a so-called mordant is used. The suggestion put forward is confirmed by the statement that the flagella appear to be thicker than they are supposed to be actually, and the organisms themselves are larger after the use of a mordant than when stained in the ordinary way.

There are dyes which have the effect of staining the flagella deeply and producing a thickening, but it is observed that, as these colors fade, the flagella become increasingly fine until at last they are no longer visible.

This is a subject in which, to the ordinary microscopist, few opportunities are afforded of making experiments a good service would be rendered if some really definite and permanent process, based on an understood system, could be formulated.

FINE ADJUSTMENTS.—In the details of the construction of microscopes, as in fact in every other instrument or machine, there is no real finality, and each year sees the introduction of some slight improvement which may tend to make work easier and more accurate. A study of the catalogues of the various microscope manufacturers of a year or two ago will afford food for reflection, for nearly every noted maker then expressed his unbounded confidence in his particular form of fine adjustment. One states that his "must be considered to be a triumph of mechanical skill," another "has proved absolutely satisfactory," and a third "its reliability is unsurpassed." Yet within the space of a few months nearly all the leading makers found it desirable to introduce new devices for fine adjustments. All of them have distinctive features, indicating that care and consideration have been given to their design, and it will probably prove of interest to readers to be made acquainted with such particulars as I have been able to collect from the various makers, for every new idea which enables the worker to manipulate more precisely than available means have permitted him formerly to do, should receive both consideration and recommendation.

A perusal of the paper read before the Royal Microscopical Society, by Mr. E. M. Nelson, and reported in the Society's *Journal* for August, 1899, on the "Evolution of the Fine Adjustment," conveys some idea of the gradual improvement that has taken place in the movement.

Those who use a substage condenser giving a small aplanatic cone will probably not feel the necessity of a better fine adjustment than that which is usually fitted to student's stands having the direct pillar action.

Directly an illuminating cone bearing a fair proportion to the numerical aperture of the objective is used, the necessity for a slow and precise movement by fine adjustment becomes overwhelmingly apparent.

In a previous article we referred to the fact that many new substage condensers yielding large cones of illumination had been recently introduced, and as the supply of such articles must indicate a demand, it necessarily follows that the people who have used them have discovered the weakness in the fine adjustments of their instruments, have called for something better, and response is being made by manufacturers to meet this fresh demand.

There are four new fine adjustments which I propose to review, as follows :—The Continental pillar fine adjustment with levers, designed by Reichert, of Vienna ; the new fine adjustment fitted to their photo-micrographic stand, by Zeiss ; the "Ariston," by Swift and Sons ; and Stringer's fine adjustment, by W. Watson and Sons.

REICHERT'S FINE ADJUSTMENT.—The great weakness of the Continental pillar form of fine adjustment has been consequent principally on the difficulty of producing a sufficiently slow rate of movement with a direct-acting screw that would stand wear and tear. The problem has been met by Reichert's device, which consists of a screw, having a point which engages two lever arms, the upper pressing upon the lower, and being mounted from the outer sides of the pillar. To the under sides of these levers is attached a piece of hemispherically shaped metal, which has on its curved side a point which communicates the motion. A reference to the illustration in his catalogue makes this otherwise obscure description quite clear, and it will be further seen that the rate of movement is diminished by the proportions of the lever arms, which are about 2½ : 1. This would mean that if a screw of the ordinary kind were used, the rate would be reduced to 1-250 in. for each revolution instead of 1-100 as in the old pattern.

THE MICROSCOPE AND THE PHARMACEUTICAL CHEMIST.—To the busy medical practitioner, reference to the microscope for diagnostic purposes is a matter of every-day occurrence. Those who have not the time or disposition to do the work themselves, have at their disposal associations and laboratories which cater to their special needs. In addition to these facilities, it is becoming usual for pharmaceutical chemists to make themselves acquainted with the wants of medical men in these respects, and to be prepared to make the examinations, and to provide themselves with the necessary modern apparatus for so doing.

The microscope is becoming increasingly important in the curriculum of the pharmaceutical student, and it is in no small degree due to this profession that so many of our food and drugs that once were adulterated, are now purer and of better quality. Powdered drugs and spices were frequently mixed with starches, flour, etc., but the microscope quickly discloses such foreign materials. The knowledge of active constituents and other cell contents of medicinal plants, and their distribution in different tissues and organs is becoming increasingly comprehensive and accurate, and experiments aided by the use of special micro-chemical reagents are in progress to identify the vegetable alkaloids and related substances microscopically.

It is satisfaction to know that work of so thorough a nature is in progress, and it is a guarantee that with increased and more general expert knowledge, our food, drugs, and other commodities will be purer and finer than they have been.

THE WORKSHOPS OF E. LEITZ, WETZLAR.—A correspondent sends a description of his visit to the microscope factory of this noted optician. The following is a short resumé:—

The output of this house is 5,000 microscopes per annum, leading one almost breathlessly to ask "What becomes of them all ?" Leitz's great feature is that he confines himself entirely to microscopes and their accessories, instead of producing scientific instruments of every description as English opticians generally do. Herein lies his success.

With a large and regular demand for certain fixed models, a system of production in which machinery plays an important part is possible, and ensures sound construction with a minimum of cost. The supervising and testing departments are of the most thorough description, and when the care that is taken is known, it is not to be wondered at that the Leitz objectives are credited with being more uniform in quality than any others.

It has many times been stated that the reason why Continental houses produce cheaply is because they employ women workers. Leitz has no female labor at all; all his men are skilled mechanics, the majority of whom have been trained in the works.

It is quite possible for English houses to compete successfully with foreign competitors if they do but adopt their methods, which may be summarised in a few words. Have the works in a country town where rents are low, and the cost of living less than in a city. Have suitable buildings for workshops, and the rest is a matter of system and machinery.

THE QUEKETT MICROSCOPICAL CLUB.—The practical work done by this Society, which was founded in the year 1865, is recognized as being of the first importance.

The meetings are attended by the foremost microscopists of the day. The journal, which is published bi-annually, and gives reports of the papers read and the proceedings generally of the club, is always worthy of careful perusal, but the great characteristic feature of the club is the welcome it extends to the amateur microscopist and the means it affords for bringing the novice into touch with the sound principles of manipulation, working and collecting.

On the first Friday in each month, a "Gossip" evening is held, at which specimens are exhibited by members and discussed conversationally, the regular business meetings of the society taking place on the third Friday in each month. There is, in addition, a first-rate library, and cabinet containing 6,000 slides, which are at the disposal of the members.

We have before hand a list of the excursions for the forth-coming season. These take place principally on Saturday afternoons, and have for their object the collecting of material that will afford interesting studies microscopically. "Pond life" has always been a very strong subject with the club. Visits are cordially invited to the meetings, which are held at 20 Hanover Square.

When it is stated that all these advantages are offered without entrance fee for the modest sum of 10s. per annum, it will be conceded that every microscopist ought to make a point of becoming a member, and so supporting, in a practical manner, a club which has in the past and will continue in the future to promote the best interests of every feature in microscopy.

Ringing Slides.—Many amateurs prepare and mount specimens remarkably well, but few manage to put the ring of cement on neatly. It requires practice certainly, but generally it is through using the cement in too thick a condition. Professional mounters have two bottles, one containing the cement, the other the solvent—generally turpentine or methylated spirits. The brush is first dipped in the solvent, then in the cement, and a thin coat is deposited on the slide as it is rotated on the turntable. Some build the ring up at once, others allow the first layer to dry and then complete the process: if there is sufficient time available the latter is the better way, but each time a fresh brushful of cement is taken, it should be preceded by a dip in the solvent. The cement can then be deposited with cleanness and regularity.—*Knowledge.*

BIOLOGICAL NOTES.

L. H. PAMMEL.

STUDIES IN CYPERACEÆ.—Mr. Theo. Holm, well-known for his studies in vegetable anatomy, has issued another paper upon the above topic. Before taking up the anatomy of Vigneæ (astrostachyæ) he discusses briefly some of the main facts brought out in his studies of other species in which the following important facts are brought out with reference to the Utriculus. "If it were not that this organ possesses such excellent morphological characters, by which our species of Astrostachyæ may be readily distinguished from each other, one would naturally suppose that the number of the species were much smaller, by examining the anatomical structure. The fact is, when we examine the structure of utriculus, we do not find any points of importance by which these species may be distinguished anatomically. The differences are so slight and seem merely to depend upon a relative broader or narrower mesophyll and a larger or smaller number of isolated stereome-bundles, that none of these may be considered as being neither constant nor of sufficient importance to be used as anatomical characters. When we finally compare the morphological and anatomical characters with each other, it seems as if our species may be naturally classified as representing a section of Vigneæ. The transition from the "hebetatæ" to the "centrales" seems very gradual and as we have shown in the preceding, none of these species possess characters that stand as isolated among the others, either in morphological or anatomical respects. The drawings, as usual, are excellent. (Am. Jour. Sci. 11 : 205, 1901.)

THE HAUSTORIA OF VARIOUS ERYSIPHEÆ.—G. Smith discusses the anatomical and structural characters of the Haustoria with several species of this family. The haustorium contains a nucleus ? The nucleus of the host plant is more or less disorganized, the outer wall of epidermal cells becomes thickened and forms a centripetal ingrowing membraneous body, which the pedicel of the haustoria must push inward. After this growth into the cavity of the cell, the haustoria is surrounded by a sheath which consists of the plasma membrane of the host plant, and unchanged cellulose. (Bot. Gaz. 29: 153.)

CENTROSOMES.—The subject of centrosomes finds a further exemplification and confirmation by S. Yamanouchi. He was unable to find the centrosomes in the resting nuclei of the pollen mother cells of Lilium longiflorum but it was possible to find them in the first stages of the division of the cell. He frequently found the centrosomes either on one or both poles. The material was fixed with Flemming's solution, washed with water, 70 per cent of absolute alcohol and chloroform, and imbedded in paraffine. Materials were stained with Bohmer's Hæmatoxylon and Flemming's orange method. (Beihefte Bot. Centralblatt, 10: 301. 1 pl.)

ARE THERE BACTERIAL DISEASES OF PLANTS ?—Dr. Erwin F. Smith has just distributed separates of his four papers on the above topic published in the Centralblatt f. Bakt. Parasit.u Infekt. The papers are of unusual excellence, showing the normal pathological conditions of the plants affected by various organisms, the figures being made from photographs. Dr. Smith discusses the evidences pro and con of the various diseases investigated by himself with some of the collateral work carried on by other investigators. Dr. Smith is well-known for his careful investigations along the line of pathology and his many experiments leave no question of the diseases discussed by him being caused by micro-organisms. It is strange that so noted an authority as Fischer should doubt that there are any bacterial diseases of plants when these facts are well recognized by most plant pathologists.

ACTION OF HYDROCYANIC ACID ON SEEDS.—Mr. C. O. Townsend in a paper on the effect of hydrocyanic acid gas upon grains and other seeds, concludes that dry seeds may be fumigated with the usual strength of the gas for the length of time required for the infection of animal life, without in any way interfering with the germ power of the seed. Dry seed may be subjected for several months to the influence of hydrocyanic acid gas at the rate of a gram or less of KCN per cubic foot without entirely destroying the ability of the seed to germinate. Seeds soaked twenty-four hours or more will not germinate in a gas stronger than 0.003 gm. of potassium cyanide per cubic foot. Seeds soaked thirty-six hours will germinate more readily than when soaked only twenty-four hours, but will not germinate in a stronger atmosphere of hydrocyanic gas than 0.0003 gm. of potassium cyanide per cubic foot. (Bot. Gaz. 31 ; 241.)—L. H. PAMMEL.

Notes on Microscopy.

F. SHILLINGTON SCALES, F.R.M.S.

INSTANTANEOUS PHOTOMICROGRAPHY.—Mr. A. C. Scott, has devised an arrangement by which he has been able to obtain instantaneous photographs of microscopic living organisms. A powerful light is, of course, necessary,and in his own work he has used an arc light of 2,200 volts, giving about 4,000 candle-power. This light is placed at a distance slightly greater than the focal length of the condensing lens to obviate such concentration of heat as would be detrimental to the microscope objective. The camera is of the usual vertical type, but the important essential is a combined shutter and view-tube, which is clamped by means of three thumb-screws to the draw-tube of the microscope ; this apparatus is fastened above the ocular, and after the latter has been inserted in the draw-tube. The mechanism of this apparatus is described as follows: "Upon a movable brass plate inside a light-tight box is a 99° prism, mounted in such a way that all the light which passes through the microscope is projected upon a piece of ground glass at the end of a cone, which may be lengthened or shortened in order to give correct focus to the object, when it is properly focussed upon the ground glass of the camera directly above the microscope. Next to the prism is a hole in the brass plate for allowing light to pass from the microscope directly to the photographic plate, when the prism is moved by a spring and pneumatic release, and finally a sufficient area of the brass plate to cover the opening when exposure has been made. To take a photograph, the microscopic animal is placed in a drop of water upon a suitable glass plate, the light is turned on and the shutter so set that the object may be focussed upon the ground glass of the cone. The plate-holder is inserted and the dark slide drawn, leaving the plate exposed inside the camera bellows. The movements of the animals are easily seen upon the ground glass, and when the desired position is obtained the shutter is released, the prism moves out of the way and the light passes to the plate." The apparatus is not yet perfected to its inventor's complete satisfaction but he states that exposures as short as one-fortieth of a second have been very satisfactory, and considers that thoroughly satisfactory negatives can be obtained with low-power objectives in one-hundredth of a second. The magnification has, however, ranged up to 200 diameters. Mr. Charles Baker, of High Holborn, in his last catalogue, mentions a somewhat similar arrangement for instantaneous photomicrography in which a pneumatic shutter with a prism attachment enables the object to be viewed on a ground-glass screen at right angles to the optic axis up to the moment of exposure. Mr. Andrew Pringle, in his well-known book on practical photomicrography, describes a vertical camera for the same purpose, but of different construction. This camera is fitted with a pair of "goggles" and a velvet bag for the head. An instantaneous shutter, made of thin sheet aluminium, lies almost in the plane of the sensitive plate and bears white discs upon which the focussing is done, and the image is watched until the time for exposure.—*Sci. Gossip.*

MICROSCOPICAL MANIPULATION.

BLEACHING BONE.—Place articles in a glass vessel with oil of turpentine, expose to sun for three or four days, a little longer in the shade. Turpentine acts as oxidizing agent, forms acid liquor, which sinks to bottom of vessel, and strongly attacks bones if allowed to touch it. To prevent this they should rest upon strips of zinc, so as to be a fraction of an inch above bottom of vessel. It also applies to ivory and woods of various kinds. Prepare solution of fresh chloride lime 1, water 4. Put bones in this and allow to remain for a few days. Then take out, wash, and dry in open air. Place in mixture of unslaked lime, bran and water, boil until free from fatty substances, and are white. Pour oil of turpentine over them in tin box, which can be hermetically closed, let remain for ten hours, remove, and boil for three hours in soft-soap water. Skim off impurities, cool hot water with cold, dry bones on pine boards in open air, protected from the sun.—*Eng. Mech.*

COLORING MATTER OF ALGÆ.—R. Kolkwitz (Chem. Centralblatt), says the color of the cyanophyceæ, which are so abundant in the effluent of sugar works, and are met with both in fresh and salt water, is due to the presence in the plants of a fine indigo-blue water-soluble coloring matter, phykocyanin, as well as chlorophyll. It may be obtained in a crystalline state by treatment with ammonium sulphate, in the same manner as albuminoids may be precipitated. It is improbable that this body exercises any toxic effect upon fish; the harm caused to them he attributed to the presence of putrid algæ in the water.

BACTERIOLOGY.

Widal's Reaction in Typhoid Fever.—The typhoid culture must be in a suitable condition; this is best effected by making the stock culture on agar agar,and keeping it at 37 deg. C.; and this must be renewed once a month. When the test is to be applied, a loopful of the culture on the agar is planted in a tube of sterilized bouillion and placed in the incubator for eighteen hours. At the end of that time a drop is examined under the microscope, to see whether the bacilli are active and that no clumping is present.

The serum should be carefully diluted at least one in twenty before the culture is brought into contact with it. If the reaction is obtained with serum of this strength you may be sure that ninety-nine times out of a hundred the serum has been obtained from a patient who has been attacked with enteric fever. The 1 per cent is allowed for errors in technique, and also because it has been reported at serum obtained from cases of abdominal typhus has given the reaction. It is a question whether these causes are not a mixed infection of typhoid bacilli, with some other organisms.

Bacteriology.—Dr. W. C. Mitchell is professor of microscopy in Denver Medical College. The laboratory work consists in the use of culture media and staining reagents; cultivation and staining of pathogenic organisms; clinical methods of detecting tubercle bacilli in sputum, urine, etc.; method of detecting the bacillus of diphtheria; bacteriological examination of water, ice, milk, etc.

Preservation of Eggs.—Dr. N. Hanika (Landwirth, Woch. f. Bayern) says that he has found in the pores of even newly-laid eggs, micro-organisms which cause decomposition; and that it is evident from this that methods of preservation which aim only at the exclusion of the atmosphere must consequently be useless. He proposes in place of the various processes now in use the following novel one which he says attains the desired end completely. The eggs to be preserved, which should be as fresh as posible, must be examined closely, by tapping and otherwise, to guard against cracks or breaks in the shell. They are then laid in water of about 95° F. for about fifteen minutes, or until they are well warmed throughout. Every particle of dirt should be removed from the shells by wiping with a sponge wet with warm water. The eggs are then put, in suitable quantities, in a sieve, net, or loosely woven basket, held for five seconds in boiling water and removed thence as quickly as possible, into cold water. The eggs, still wet, are laid on a clean linen cloth and let dry off spontaneously by exposure to the atmosphere. Under no circumstances should they be dried off with a cloth or towel. As soon as they are quite dry they are packed in a box with either ground peat, sifted wood ashes, wheat chaff, wood-wool, or wheat bran, the packing material to be made thoroughly dry by heating before using. The five-second dip in boiling water was sufficient not merely to kill the microbes in the shell substance and between it and the inner skin, but to cause the coagulation of a thin but all-sufficient layer of albumin lying next the skin, and thus form an impassable barrier to the exit of water and entrance of air,with its microbes.

MICROSCOPIC INSPECTION OF PORK.—The number of carcasses examined in 1900 was 999,554, resulting in the following classification: Class A, free from all appearance of trichinæ, 968,405, or 96.88 per cent; Class B, containing trichina-like bodies or disintegrating trichinæ, 11,701, or 1.17 per cent; Class C, containing living trichinæ, 19,448, or 1.95 per cent. The number of certificates issued for 253,333 inspected packages was 12,107; covering a weight of 55,809,626, pounds. There was a great falling off in the trade in microscopically inspected pork products. The cost of this work was $154,950.22; average per carcass, 15.5 cents; per pound exported, 0.277 cent. For 1899 the cost was $198,355.14.

INTERNATIONAL ASSOCIATION OF BOTANISTES.

Several leading botanists of different countries being convinced, that a better organization would contribute in a most desirable manner to the mutual aim viz. the progress of botany, have the honor to invite you to become a member of a new Society to be called the *International Botanical Association*. A general meeting will take place at Geneva (Switzerland), on the 7th of August next in the botanical laboratory of the University at 10 a. m. During this meeting several questions will be submitted to the judgement of the members and you are invited to propose orally or in writing such measures as you think it desirable that the new Society should adopt. The chief object of the Association will be the foundation of a bibliographic periodical criticising in a perfectly impartial manner all botanical publications. The criticisms will—at the desire of the contributors be published in English French or German. All will be submitted to the judgement of an editor nominated by the Association and responsible to it.

It is most desirable that the membership be as wide as possible, since this is the only way of making membership inexpensive. Under no circumstances the membership will cost more than $6.00, including the gratis delivery of the periodical. Another great advantage of the new Society is that by its means members who live in different parts of the globe will be brought into more intimate contact one with another and this will greatly facilitate the procuring of material for investigation and demonstration. Application for membership should be sent to: Dr. I. P. Lotsy, Wageningen, Holland.

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The Viability of the Bacillus Pestis.

M. J. ROSENAU.

We now know that this organism may live for months, and even years, in a test tube, on a moist albuminous medium. And the present work shows that even when dry it may live over four months, provided the temperature is cool—less than 20° C. The bacillus of plague can in no sense be considered a tender organism, as was at first supposed. It is much easier to cultivate than the lanceolate coccus of pneumonia or the pathogenic streptococci. In this respect it resembles more closely the hardier of the hemorrhagic septicæmic group.

We tested the life history of this organism upon a great variety of objects and under various conditions. We attempted to imitate nature. But we can not imitate all the conditions under which the organism may exist in nature, and we ought not, therefore, to apply the experience of the laboratory too literally to the life history of the plague bacillus outside of the body. We may determine with fair certainty the length of time the bacillus may live under given conditions. But these conditions are more or less arbitrary, and to a certain extent artificial. In general terms, we can state whether it is a hardy organism, resistant to influences usually detrimental to bacterial life, or one that loses its virulence and dies quickly when removed from its natural habitat. The bacillus of plague does not exist in nature on sterile glass-cover slips, nor yet in the desiccator over concentrated sulphuric acid, which were conditions used by some authors who have reported their results on this question.

The test objects were very abundantly inoculated with a pure culture of the bacillus pestis of known activity and virulence. Often the test objects were saturated. The cultures had been grown for a long time upon artificial media in the laboratory, so that their vitality was probably strongly influenced. It is a well-known fact that virulent pathogenic bacteria may at first grow very poorly upon the ordinary laboratory media, but by successive cultivation they become accustomed to the new conditions, so that they finally thrive abundantly ; that is to say, they take on a sort of saprophytic existence. Such cultures would doubtless resist the various influences to which they are exposed in the laboratory tests better than another race direct from the blood or tissues. In fact, it is found that the plague bacillus in the blood and tissues from a rabbit usually dies out rather quickly when dried upon the test objects. On the contrary, bouillon cultures dried on similar objects and under similar conditions live a much longer time.

Another departure from normal conditions was the fact that all the test objects receiving the abundant inoculations of the virulent pure cultures were sterile. In other words, not only were cultures of the bacillus used that were accustomed to a saprophytic existence, but these cultures were placed upon sterile test objects and protected against contamination, so that they were relieved from that microbial symbiosis which, in the economy of nature, plays so important a part in the suppression of pathogenic micro-organisms. It is known that in organic mixtures the hardier saprophytes tend to overpower the bacillus pestis.

PLAGUE AND FOOD.—Our experiments show that food products may harbor the infective principle of plague, but according to experience food products are not much to be feared as far as their probability of carrying the infection is concerned. This latter statement does not apply to milk and its products, for milk is a good culture medium for the bacillus pestis ; and we kept it alive seventeen days in cheese and seventy-two days in butter. On the surface of food products it usually died very quickly. It did not live twenty-four hours on orange peel. We had similar results with figs and raisins and a large quantity of Chinese food products, such as smoked and dried ducks, dried oysters, dried cuttle fish, dried ducks' gizzards, ducks' gizzards dried and placed in oil, smoked and dried pork, and duck eggs preserved in a mixture of mud and rice chaff, all of which were infected with the bacillus pestis and kept at 37° C. In rice we found it alive eighteen days after inoculating.

These results correspond with all our other experiments, which plainly prove that the bacillus cannot live long on the surface of objects, when dry, at temperatures above 30° C. In one case we kept it alive one hundred and sixteen days, and in another ninety-six days, in water preserved at low temperatures, 17° to 19° C. Under the same conditions the organism lived only six days at 37° C.

TEMPERATURE.—The effect of temperature upon the bacillus pestis is very remarkable. It may be kept alive and virulent a very long time in the cold, even though dry, but it cannot live long when dry at the temperature of the body. High temperatures, such as 70° C. or more, are invariably fatal in a few minutes. It was this that led some of the early workers to conclude that they were dealing with a frail organism. It is frail when dried at 37° C., but may live for months in the cold. We have never been able to keep it alive more than a few days when dry at 37° C.—three days in flannel, two days in sponge. On the contrary we had little difficulty in keeping it alive on a variety of objects three and four months at 17° to 19° C. The bacillus is not as sensitive to temperature when kept moist, for under such conditions it will live a very long time in albuminous media at 37° C. From the experimental studies with the plague bacillus we would infer that the endemic foci of plague should be in cold climates.

Moisture is a definite factor in the viability of the bacillus pestis. The organism must have moisture to grow, and it may remain alive and virulent a very long time in the presence of moisture. It usually dies quickly when dry. However, this is not invariably the case. We have been able to keep it alive in media such as dried albumin for one hundred and twenty-five days, when it was still virulent for mice. But to keep it alive when dry the organism must be cold, i. e., exposed to a temperature less than 20° C. In no instance could the organism be kept alive when dry at a temperature of 37° C. for more than a few days.

Our experiments confirm those of other workers in this field, who find that for the most part the bacillus pestis soon dies when exposed to bright sunlight. Our work leads us to the conclusion that the heat as well as the sunlight plays an important role; also that the effects of the sunlight do not penetrate very deeply. It is therefore safe to say that objects may be efficiently disinfected on the surface by exposing them all day to a bright sun, provided the temperature in the sun is above 30° C. The plague bacillus was kept alive a long time in moist garden earth, especially when kept cool. It dies very quickly in dry earth. We were not able to keep it alive longer than twenty-four hours at any temperature in dry earth. As moist earth will preserve the life of the bacillus it is easy to understand how the infection may live in dirty dwellings. It requires no stretch of the imagination to understand how the infection may be conveyed by the dirt and dust of moist, sunless habitations.

We have not succeeded in keeping plague alive very long when dried upon the surface of objects ; even on plush, carpet, paper, wood, sawdust, bone, etc., it usually dies within a few days. In porous substances such as sponge we found it alive after one hundred and twenty-five days, when allowed to dry, at 19° C. Here again temperature plays an important role, for at 37° C., all the other conditions being the same, it lived only two days.

A bacillus of plague lives long in albuminous matter. Clothing and bedding are especially apt to be contaminated with the discharges from buboes and blisters, sputum, etc. Articles so infected and kept in a cool, moist place could retain the active infective principle a very long time. Clothing and bedding may harbor the bacillus of plague for months. In one instance we kept it alive on a piece of crash ninety-seven days ; in albumin gelatine balls one hundred and twenty-five days ; in sponge, also, one hundred and twenty-five days ; in wool fifty-two days.

According to our results the plague bacillus cannot live long in letter mail. In seven tests made with cultures of the organism on paper we found that it usually died within twenty-four hours. At most it kept alive eight days on paper allowed to dry, and fourteen days on paper kept in a moist atmosphere. To live this long it must be kept cool, for, just as in all our other experiments, it died very quickly when dried at the body temperature. We had similar experiences with plague blood upon paper.

The bacillus pestis often loses its virulence before it dies. In many of our experiments we found that the time came when the organism grew in bouillon, but lost its pathogenity for animals. This is an important fact from an epidemiologic standpoint, for an attenuated plague bacillus is probably harmless to man, even though its virulence be increased by artificial means in the laboratory.

The experiments conducted in this laboratory plainly prove that either sulphur dioxide, when moist, or formaldehyde will kill the bacillus pestis when applied in the strength and methods usually employed for these gases as disinfecting agents. In order to be effective there must be directed contact between the gas and the germ. In other words, these gaseous disinfectants can only be depended upon as surface disinfectants.

As far as practical disinfection for plague is concerned, it may be mentioned here that sulphur dioxide is probably a much more useful agent for use of ships, stores, houses, and dwellings infested with vermin, because it is destructive to the higher forms of animal life, whereas formaldehyde fails to kill mammals and insects with the same certainty that it kills microbes. In combating plague it is very important to kill fleas, rats, mice, and other forms of animal life capable of carrying the infection. Sulphur has this power, which formaldehyde totally lacks. A great number of tables exhibit details of experiments which cannot be reported here.

CONCLUSIONS.

1 The bacillus pestis is not a frail organism. It resembles the hemorrhagic septicæmic group or the coccobacilli as far as its viability is concerned.

2 Temperature is the most important factor in the viability of the plague bacillus. It keeps alive in the cold, under 19° C., a very long time. It dies quickly, especially when dried, at the body temperature, 37° C.

3 Moisture favors the life of the bacillus pestis. It usually dies in a few days when dry, even in the presence of albuminous matter, provided the temperature is above 30° C. It may keep alive and virulent when dry for months in the cold, under 19° C.

4 Sunlight kills the organism within a few hours, provided the sun shines directly upon the organism and the temperature in the sun is over 30° C. The effect of sunlight is not very penetrating.

5 The virulence of the bacillus pestis is often lost before its vegetability.

6 It is unlikely that new dry merchandise would carry the infection. The organism usually dies in a few days on the surface of objects such as wood, sawdust, bone, etc.

7 Clothing and bedding can harbor the infection for a long time and may act as fomites. The bacillus lives for months when dry in albuminous media at temperatures under 20° C.

8 Food products may carry the infection of plague. The bacillus lives a long time in milk, cheese, and butter. It usually dies quickly on the surface of fruits and perpared food.

9 The organism may live a long time in water, although plague is not a water-borne disease.

10 The plague bacillus does not live long on paper, and first-class mail is therefore not apt to convey the infection.

11 The colder the climate the greater the danger of conveying the infection on fomites—clothing, bedding, food, merchandise, etc.—and more extensive disinfection is required in such a climate in combating the disease than in tropical regions.

12 The plague bacillus is destroyed by sulphur fumigation and by formaldehyde gas in the strengths in which these disinfectants are usually employed. The gases can only be depended upon as surface disinfectants. In disinfecting ships, warehouses, dwellings, and other places infested with rats, fleas, and vermin, sulphur is better than formaldehyde, because formaldehyde gas fails to kill the higher forms of animal life.

13 A temperature of 70° C. continued a short time is invariably fatal for the plague bacillus. The ordinary antiseptics are all efficacious in their usual strength for non-spore-bearing organisms. Efficient surface disinfection may be accomplished by exposing objects all day to the direct sunshine on warm days. The temperature in the sun must be above 30° C.

Work on Ciliate Infusoria.

In a recent bulletin of the California Academy of Sciences, N. M. Stevens has described two new Infusorial forms. During his studies he worked on them microscopically and writes, in part, as follows :

Technique.—The respiratory tree was removed from the living holothurian, plunged into the fixing fluid, and later washed, and hardened in alcohol. Small pieces were imbedded in paraffine in the usual way, and sections 5 to 7 microns thick were cut and mounted in series. For *in toto* preparations, portions of the respiratory tree were stained, washed, and run into glycerine or through alcohols, followed by clove oil, teased upon the slide to free the infusoria from the respiratory membrane, and mounted in glycerine, glycerine jelly, or balsam.

A large number of fixing agents were tried : picro-acetic, picro-sublimate-acetic, Gilson's fluid, sublimate-acetic, iridium chloride-acetic, Flemming's strong and weak solutions, Vom Rath's solution, platinum chloride-acetic, Hermann's fluid, absolute alcohol, absolute-acetic, palladium chloride, Rabl's fluid, bichromate-osmic, and osmic vapor.

Hermann's fluid gave the best results, though sublimate-acetic, absolute-acetic, Boveri's picro-acetic, Flemming's and Vom Rath's solutions proved quite satisfactory, and osmic vapor was especially valuable for temporary *in toto* preparations in the study of division stages.

Peptone and pepsin solutions, bichromate of potash (one to three per cent), formalin (one-tenth to one per cent) and fresh water were employed as macerating agents; of these, potassium bichromate (two per cent) was found to be of greatest value in revealing and isolating in internal fibre structures of *Licnophora.*

The principal stains used were Delafield's hæmatoxylin, dahlia, bismark brown, thionin, methylen blue, acid fuchsin, borax carmine, alum carmine, picro-carmine, Mayer's paracarmine, light green, safranin, Heidenhain's iron-hæmatoxylin, rubin, and ruthenium red. For fresh material picro-carmine and alum carmine gave the best results ; borax carmine, paracarmine, light green, and safranin were useful in the study of fixed material *in toto;* for sections no other stain was at all comparable to Heidenhain's iron-hæmatoxylin following Hermann's fixing fluid, and used either alone or in combination with rubin or with ruthenium red.

Structure and General Biology.—Licnophora like most of the Ciliata has a delicate structureless pellicula not distinguishable in life, but readily separated from the cytoplasm by macerating fluids and by many fixing agents. The ectoplasm is clearly marked only at the margin of the attachment disc, between its cuticula and fibre layers, and within the triangular basal portion of the oral band where it is either homogeneous or very finely granulr. The entoplasm is coarsely alveolar in both discs and more finely alveolar in the neck.

Oral Disc.—The oral disc is irregularly circular in outline, having a projection on the left side opposite the buccal cavity. The ventral side is depressed centrally and posteriorly, the dorsal side convex laterally and posteriorly, but continuous with the neck anteriorly. The width of the disc varies from 33·5 micron to 57 microns in fixed material, and was 72 microns in the large living specimen cited above.

The oral ciliary band begins just above the pharynx on the left side, curves about the posterior extremity and right side, and passes with a twist under the upper lip of the mouth, where it broadens out and covers the roof of the pharynx into which its cilia descend. The band is made up of about one hundred and twenty-five transverse rows of fine long cilia which are usually twisted together in action so as to appear under low power as so many stout membranellæ, but under Abbé homogeneous apochromatic oil immersion 1·5 mm., oc. 8, the individual cilia are plainly seen in the living specimen, hundreds of them in each row forming a flat brush or a stout twist. The transverse width of these flat brushes, i. e., the width of the band, is least at the beginning of the band and is increased one-half or more in the pharynx, the average width outside of the mouth being 10 microns in large living specimens. The cilia of the several rows on the left side are most often seen untwisted in the living animal at rest; while those on the right side, where the band turns toward the mouth, are often divided, one portion extending outward, the other curving toward or into the mouth.

In sections fixed in Hermann's or Flemming's fluid and stained with Heidenhain's iron-hæmatoxylin, the oral band is seen to have a complicated internal structure. At the base of each row of cilia is a deeply stained basal band whose ends are connected by fine fibres with an internal, deeply staining fibre. A cross-section of the band presents a triangular appearance with deeply stained basal band and lateral fibres enclosing a dense homogeneous or finely granular portion. The proportions of the triangle vary greatly from the beginning of the band to its end in the pharynx.

Tracing these fibres back from the mouth-region around the peristome into the neck, their origin is found in a stout, longitudinally striated, deeply staining fibre, which arises from a branching base at the center of the attachment disc and extends diagonally through the neck to the beginning of the oral band, where it gives off a branch to each end of each basal band. The first branches given off are coarse and oblique, the later ones fine and nearly perpendicular to the basal fibre.

This stout neck fibre with its oral prolongation and branches is somewhat anisotropic, fibrous, and contractile. The only clearly differentiating stain found for it is iron-hæmatoxlin ; second to this was Mayer's picro-carmine, the material being left in the stain for forty-eight hours. In macerations, the fibre with its various branches is the most resistant part of the body. Potassium bichromate (one to three per cent) will in a few seconds, aided by slight tapping on the cover-glass, dissolve away the alveolar entoplasm and the pellicula, leaving the inner layers of the attachment disc with cilia, the neck fibres and the oral band with cilia, the skeleton of the animal. Similar results were attained with pepsin and peptone solutions, one-tenth per cent formalin, and even with fresh water. The neck fibre is faintly visible in life, and is plainly seen in any macerating or fixing fluid before the cilia of the attachment disc and pharynx cease to vibrate. These facts clearly demonstrate that the fibre and its divisions so plainly shown in iron-hæmatoxylin stained sections are not artifacts.

PERSONAL.—E. G. Eberle of Dallas, Texas, is President of the Texas State Pharmaceutical Association for 1902.

The Preparation of Crystals as Microscopic Objects.

S. E. DOWDY.

Few microscopic objects are more beautiful and instructive than the crystals of various chemicals, prepared in such a way as to be suitable for viewing under the microscope. Most chemists possess a microscope, often a relic of student days, in which owing to a dearth of fresh slides, they take no further interest. The obvious remedy for this state of affairs is either to purchase more objects or to prepare some on one's own account. Where possible, the latter is much the better course to adopt, as good home-made slides are far cheaper, more typical, and instructive than bought ones. These few notes will, I trust, serve as a rough guide to the *modus operandi* to be observed in preparing this class of objects. The materials are to hand in every pharmacy, the other items required o ensure success, viz., knowledge of the solubilities of the various chemicals under trial and a certain amount of patience, should also be to hand. The other essential repuisites are a few thin 3 by 1 inch clear glass slips, some medium thickness round cover glasses, a small quantity of Canada balsam dissolved in xylol, test-tubes, spirit lamp, glass stirring rod, and a small pipette.

Before starting work it is necessary to get the slips and cover-glasses perfectly clean and free from grease. That can be easily done by washing them with ammonia, rinsing with distilled water, drying them on a clean cotton rag, and finally polishing them on a piece of chamois leather. When these are ready, one of the three following methods can be adopted to prepare the slide. The first consists of evaporating down a saturated solution of the salt until enough moisture has been driven off to enable the crystals to rapidly form on cooling. The practical application of the process is as follows : Make a saturated solution of the salt in distilled water and deposit a drop with the pipette in the centre of a 3 by 1 inch slip; slope the slide to make the liquid spread in a film, then absorb the superfluous moisture from the side of the slip with blotting paper. Now hold the slide wet side up over the flame of a Bunsen or spirit lamp, at such a distance that the liquid just steams. Continue this until you see a thin film of the salt form at the edges, then withdraw, allow to cool, and examine under the microscope. If satisfactory, the crystals can then be permanently mounted by depositing a drop of the cold xylol balsam over the film and covering with a clean cover-glass.

When the salt is insoluble in water, any suitable solvent such as alcohol, chloroform, etc., may be employed; in this case, of course, evaporation will take place rapidly without the aid of heat. Crystals formed from such solutions will probably require a different mounting medium, such as castor oil, or one in which they are not soluble. A method recommended by Dr. Lankester is to dissolve a little gelatin or gum acacia in distilled water and to add to this a few drops of a saturated aqueous solution of the salt. A drop of the warm mixture is then deposited on a slip, superfluous moisture drained off, and the slide is put on one side to cool. With some salts—copper sulphate, iron sulphate, etc.—remarkably beautiful crystalline forms make their appearance, frequently in the form of flowers and fern-like branches. Epsom salts, chlorate of potash, bichromate of potash, and, in fact, any salt soluble in water will lend itself for preparation by the above process.

The second principal method is by fusion. Its application is necessarily more restricted than the foregoing, but by its means some very effective slides may be prepared. The process is equally simple, but the results attained will not be so uniformly successful. A good substance to experiment with is salicine. Place a small quantity on the centre of a thin slip and heat it over a flame until it just fuses, withdraw it from the heat before it chars, and allow it to cool gradually. If successful, small circular plates or rosettes will appear on the film, and these may be mounted in the usual way in cold xylol balsam. A good slide of this description, viewed with dark ground illumination, or by polarised light, will fully repay any trouble involved in preparing it. This method is useful in enabling one to prepare totally different physical forms from the same salt. With salicine, for instance, an aqueous solution deposits needle-shaped crystals, quite distinct from the circular form obtained by fusion. A point to be observed in using the process is to avoid having too much of the salt on the slip, as on cooling, the film, if too thick, will probably star and crack. If the film should be too thick for viewing as a transparent object, it will often make a good opaque one by pasting a circle of black paper on the under side of the slide.

Another class of objects, prepared in a similar way, are crystals of fatty substances, spermaceti, hard paraffin, etc. It is only necessary to place a small piece on a slip and warm it. When melted press down on it a cover-glass, the crystal forming as the mass cools. These slides cannot compare from an artistic point of view with those obtained from salts, but are interesting from the fact that the actual formation of the crystals can be watched under the microscope any number of times by simply warming the slide before viewing it.

The third principal method is still more limited in application, being confined to those substances which are easily volatilized and crystalize on cooling. Preparation of slides by sublimation may be carried out as follows Take a dry narrow test-tube and place in it any suitable chemical—benzoic acid, for instance. Hold the tube over the flame until the acid volatilizes, now invert the tube and stand it on a cold 3x1 in. slip. The characteristic crystals will form on the part of the slip covered by the tube, and, if satisfactory, can be mounted in the usual way. Camphor, arsenic, and many others will suggest themselves as suitable for preparing slides in this way.

The three methods described will practically cover the whole ground of preparing crystals for the microscope, and with the expenditure of a little time and patience will enable anyone to materially increase, at a nominal cost, his collection of slides. If mounted in a suitable medium, and preserved from undue heat and light, these slides will be permanent; any change which may take place in the forms of the crystals may be put down to the solvent action on them of an unsuitable medium.–*Pharmaceutical Journal.*

Notes on Microscopy.

F. SHILLINGTON SCALES, F.R.M.S.

STRIDULATING ORGANS IN BEETLES.—C. J. Gahan in "Trans. Entom. Soc." London, 1900, pp. 433-52, comments upon Schrodte's discovery of well-developed stridulating organs in the larvæ of several genera of beetles, and on the fact that the structures are generally alike in both sexes of adults, though with some notable exceptions. He describes the stridulating organs on the head, on the prothorax and front legs, on the mesothorax and middle legs, and on the hind legs, elytra, and abdomen.

ROTATORIA OF THE UNITED STATES.—In the "U.S. Fish Commission Bulletin" for 1899, pp. 67–104, are give all species of rotifers , 246 in number, hitherto found in the United States, with special reference to those discovered by the author in the great lakes. Two species *Notops pelagicus* and *Pleurotrocha parasitica*, are described as new. As a general result of his investigation the author formulates the conclusion that the Rotatoria are practically cosmopolitan, any species occurring wherever the conditions necessary to its existence are to be found. In stagnant swamps all over the world are likely to be found the characteristic rotifers of stagnant water, with little regard to the country; in clear lake-water, everywhere, the characteristic limnetic Rotifera may be obtained; in sphagnum swamps the Sphagnum or moss Rotifera. Variation in the rotifer fauna of different countries is probably due to variation in the conditions of existence in the waters of those countries, not to any difficulty in passing from one region to another. In the introduction the author gives a word of warning against the naming of species by those persons who, through want of experience or knowledge of what is known, are not in a position to differentiate new forms. Such work he describes as a positive injury to science and a nuisance to all careful scientific students. It is to be hoped that everyone wishing to describe a new species of rotifer, will learn by heart and inwardly digest this sentence. In the very next paragraph the journal refers to a contribution on this subject in the "Trans. New Zealand Inst." by Mr. F. W. Hilgendorf, which comes under the above strictures. The author succeeded in finding sixteen species of rotifers, twelve of which he describes as new. Half of these can at once be recognized as old acquaintances, and the other half are of no value, and scarcely to be identified as rotifers. The figures of the four plates, remarks the writer of the notice, bear about the same relation to rotifers as the wooden blocks in a child's Noah's Ark do to the animals they pretend to represent.

SCALES OF FISHES.—The scales of fishes are objects of much interest to the geologist and zoologist as well as to the microscopist, and are therefore at all times an interesting study. They are important features in classification, throwing light on the conditions of the waters inhabited by their possessors, and contribute not only to the understanding of the conditions and life of the present seas, but add their quota to the sum of our knowledge of the former conditions of life upon the earth. The scales of fishes, unlike the scales of most reptiles, are not epidermal appendages—*i. e.*, they do not grow upon the skin, like hairs, nails, or hoofs, but are produced within the substance of the skin, and are covered throughout their extent with a layer of it. A cursory glance will show that the scales figured in books are of two kinds, those having a comb-like appearance at one end, and others without this characteristic. The former are known as "ctenoid," and the latter as "cycloid." In the ctenoid the comb-like end is the free end, the scolloped part being imbedded in the skin. The scales are so arranged in relation to each other that the water glides from the edge of the one on to the middle of the next. The scales ove - lap in the direction from head to tail of the fish. Two objects are attained. The fish swims with the least possible amount of friction, and the underlying skin is shielded from the constant maceration to which it would be subject if the water were perpetually soaking between. Unlike the armour-plated "placoid" and sheeny-coated "ganoid" fishes of the geologic seas, which still have their representatives in our modern waters, the scales here described are delicate and flexible. "Ctenoid" and "cycloid" differ in appearance; but whether comb-like or rounded the structure is very much the same. An examination will show a number of consecutive lines which correspond approximately to the shape of the scale. A little careful focussing reveals also that the scale, however thin, is thicker at the centre and thin towards the edges. In some scales the concentric lines are continuous across the furrows formed by the deep radiating lines of the upper half· In the flounder and the perch they do not meet, but are broken by a line of transparent matter which appears also to line the whole scale on its underside. The explanation seems to be that the scale grows by the addition of a new layer to its underside, slightly larger than the last, the boundary edge of which forms the characteristic concentric line. In those scales in which the concentric lines do not cross the furrows the outer layers split as they harden, the interstices being filled with the newly formed transparant matter, and this goes on during the whole of life. The thin flat scale of the eel,which must be searched for beneath the skin, as it does not project from the surface, is a very beautiful object. At first sight, when viewed through a 1-inch objective, it appears to be of a cellular character, but careful study with a ¼-inch and a little management of the illumination shows this appearance to be caused by isolated concretions of carbonate of lime set in a layer of the same. Similar concretions may be easily seen in several of the scales between the outer laminae and the inner transparant layer. All scales are very beautiful ; some of them are still more interesting through being mounted as opaque objects. Viewed by polarised light they are of course charming.—*J. Lucas.*

Fish scales make beautiful objects, when viewed with reflected light, the scales of sole being often exhibited in this way, with the light falling on them in such a manner as to show the comb-like teeth. As transparent objects they can be examined with the spot lens or equivalent arrangement, and with polarised light either with or without a selenite plate. As opaque objects it is only necessary to clean and dry the skin ; as transparent objects the skin must first be dried and then mounted in Canada balsam. The following is the classification suggested by Agassiz, though subsequently modified, as quoted in the "Micrographic Dictionary." Scales enamelled : Ganoid fishes.—Those the skin of which is regularly covered with angular thick scales, composed internally of bone and externally of enamel. Most of the species are fossil, the sturgeon and bony pike being recent. Placoid fishes.—Skin covered irregularly with large or small plates or points of enamel. Includes all the cartilaginous fishes of Cuvier except the sturgeon. As examples may be mentioned the sharks and rays. Many are fossil. Scales not enamelled: Ctenoid fishes. Scales horny or bony, serrated or spinous at the posterior margin. Contains the perch and many other existing species, but few fossil. Cycloid fishes.—Scales smooth, horny, or bony, entire at the posterior margin; as the salmon, herring, roach, and most of our edible and freshwater fishes. The majority of the fossil fishes belong to the first two orders, and most of the recent to the third and fourth.—*Science Gossip.*

A Microscopic Proof of the Food of a Prehistoric Man.

T. CHARTERS WHITE.

Several years ago a barrow was opened on the downs near Warminister in which a number of human and animal remains were found heaped over the skeleton of an infant. Together with these were numerous roughly formed flint implements, indicating the period as that of the early Stone Age, the only metal being in the form of a bronze ornament of very primitive design. Having been allowed to make an examination of some of the human jaws, I now describe the condition of one as bearing on the question of prehistoric food.

It may appear impossible to affirm with any certainty the character of the food of individuals who existed probably three thousand or four thousand years ago; but the conditions under which the remains were found place us in a position to state, without any doubt, the nature of food consumed by the individual whose lower jaw is the subject of investigation. The gentleman was perfectly ignorant of the use of a toothbrush, and probably whatever performed an analogus function in others of his surrounding circle failed in his case; for his lower teeth were almost entirely covered by that salivary calculus popularly known as "tartar."

This tartar is deposited on the teeth from the lime salts held in suspension by the saliva, and by its gradual precipitation becomes a hard concrete, not soluble in the ordinary alkaline fluids of the mouth. In it, particles of food are imprisoned by daily deposition, which may remain in the same condition for ages, especially if dry. Here, then, we have this hard, solid concrete only waiting proper treatment to disengage from its calcareous confinement any particles of food closely locked up in its mass.

The method adopted was to clear all the tartar from the lower jaw and then place it in a conical drachm measure, to decalcify it by means of a weak dilution of hydrochloric acid. This solution was afterwards washed away and the sediment examined drop by drop under the microscope, a third of an inch objective being employed in the examination.

The main body of the deposit was made up of amorphous particles, probably disintegrated meal of some kind. Interspersed were numerous granules of a siliceous nature: these were fully accounted for by the extensive grinding away of the summits of the molars, which were eroded into deep pits, and must have been productive of intense discomfort, not to say pain. The granules were found when tested by polarised light to be of two characters; some that were flinty did not answer to that test, while the others did so, and were stated by an eminent geologist to be quartzite. He explained this was probably the result of the corn having been rubbed down in a roughly made quartzite mortar, with a round pebble as a pestle.

Among the first organic remains to be noticed, was the sharply pointed tip of a small fish's tooth, following which were the oval horny cells of some species of fruit resembling those going to make up the parenchyma of apples, then husks of corn, the hairs from the outside of the husks, a spiral vessel from vegetable tissue, and several small ruby-colored, highly refractive bodies which I could not recognise.

Scattered throughout the collection of sediment were oval bodies resembling starch corpuscles, such as may be found in potatoes, but as they did not give the characteristic black cross under polarised light, it was decided they could not be starch; further, any starch would have been reduced to the amorphous condition found in the general mass of the meal. Their true nature was afterwards made evident by finding a flat plate of cartilage about 1-30th of an inch square, from the free edges of which these oval bodies were being gradually extended, so, that by the disintegration of this substance these bodies in their isolated condition proved a puzzle. Here, then, was evidence that the particles of food locked up in this tartar could be recognised after a lapse of time such as must have occurred since the Stone Age in which they were massicated. No evidences were found indicative of the use of fire in cooking the food; it must therefore have been eaten raw.

Each drop as it was examined was covered by a circular cover-glass of $\frac{5}{8}$th of an inch diameter and carefully put aside; but to prevent this cover-glass from shifting, a ring of gum-dammar varnish was run round each, and after a few years these preparations were examined again, when it was found the varnish had sucked in by capillary attraction, and these slides, to the number of about thirty, were irretrievably ruined.

Should I ever be so extremely fortunate as to obtain another such specimen of undoubted Stone age antiquity I should dry the deposit at once and mount it in Canada balsam.—*Science Gossip.*

Personal.—Henry L. Ulrich, M. D., is professor of Microscopy and Bacteriology in the Department of Pharmacy, University of Dallas, Texas.

MICROSCOPICAL MANIPULATION.

The Differentiation of Human and Animal Blood by the Aid of a Specific Serum.—E. Ziemke refers to investigations of Wasserman, Schutze and Uhlenhuth, who have shown that by injecting rabbits with human blood a change is produced in the rabbit's serum, made evident by the fact that when added to dilute human blood a turbidity is caused, which does not appear with the blood of any other animal except the monkey, and describes some further tests he has made to determine the applicability of the reaction for forensic purposes. Positive results were obtained with fresh blood, dried blood, blood stains on cloth, blood in garden soil, blood from a person poisoned with carbonic oxide, blood or steel implements, blood from the wall of a cellar, blood on wood, blood in glass, blood on paper, the blood of a three-day-old corpse and putrid blood. The stains in several instances were ten or more years old, and where possible, control tests were made on the blood of the common domestic animals. In every case except one a positive result was obtained with the human blood preparations, while the animal tests were all negative; the one failure is attributed to the fact that the stain tested, which dated back to 1883, did not yield any extractive to the soda solution in which it was soaked.—*Medical Record.*

Method of Distinguishing Human Blood from that of Animals.—C. Tarchetti (Gazz. degli Osped. May 19th, 1901) describes a new procedure for this purpose: If into an animal (A) the blood of a different species (B) is injected, then after a certain time the blood of the animal (A) is found to be toxic towards blood of the species (B). Thus, by repeated injections into rabbits of human blood—10 c.cm. or four or five occasions at intervals of about a week—Uhlenhuth and Washermann got from the blood of the rabbit a serum which exhibits hæmotoxic powers to human blood, not only in a fresh state, but also when dried and redissolved in normal saline solution. Ape's blood was the only other one which behaved like human blood. Washermann and Schultze proceed thus: Dissolve the spot of blood to be examined in a little normal saline solution; filter; place 4 or 5 c.cm. in two small test tubes, to one of which (*a*) add 0.5 c.cm. of rabbit's blood made hæmotoxic as above; to an other (*b*) add 0.5 c.cm. of normal rabbit's blood. A third control tube (*c*) may be made with 4 or 5 c.cm. of solution of the blood of any animal save ape or man in distilled water. Place the solutions in a thermometer at 37 deg. C.; if the spot of blood be human, in an hour's time the tube (*a*) will show a turbidity or a floculent precipitate, while (*b*) and (*c*) will be perfectly limpid. Tarchetti carried out similar experiments with human blood and that of animals, both fresh and dried, for more than two months on cloth, wool, and knife blades, and found the method reliable. The reaction occurs almost as well at the air temperature as at 37 deg. C. The solutions must be absolutely clear to begin with, and he finds distilled water better for this purpose than normal saline fluid, for it brings all the hæmoglobin out of the corpuscles. He has found that the diagnosis can be at once made with the greatest certainty in a hanging drop under the microscope; a slight uniform precipitate is at once formed, and in a few minutes is seen as islets united in a reticulate pattern much resembling the arrangement of Eberth's bacillus agglutinated by typhoid serum. The same thing is observed in filtered aqueous solutions of dried blood. It is only after a long time (twelve to twenty-four hours) that a similar appearance is seen in blood of other animals.

CEMENT TO STAND SPIRIT.—Dissolve 12 grains of gelatine (previously allowed to swell up in cold water) in 2 oz of hot water. Add to this sufficient fresh fine plaster of Paris to make up a thick cream. Apply this at once to the metal collar and neck of bottle, and press together. The parts must be scrupulously clean and free from grease before the application of the plaster. Apply an excess of this latter, and after having pushed the parts together, wipe off the superfluity. Let it stand to set for 24 hours.

BACTERIOLOGY.

VARIABILITY OF THE TUBERCLE BACILLUS.—Carl Ramus, in the Jour. Am. Med. Assoc'n, speaking of the variability of the tubercle bacillus concludes as follows:

1. Tubercle bacilli are not so easy to demonstrate as is often believed even though present in large numbers.
2. The fuchsin solutions, like those of other dyes, cannot at all time be absolutely depended upon.
3. Tubercle bacilli from different patients, and from the same patient at different times, will not invariably stain by one method.
4. The bacilli exhibiting these varying staining properties are genuine tubercle bacilli, and not other species of acid-resisting germs.
5. The staining variations probably depended on physical and chemical changes in the bacterial substance, instituted either by antitoxic action or by the products of associated organisms, or by a combination of both.
6. In the absence of demonstrated tubercle bacilli, where physical signs of tuberculosis exist, a prompt diagnosis of that disease should be confidently made in the interest of the patient, and no valuable time be lost in waiting for typical bacilli to appear.

SPUTUM AND URINE.—Suspected cases which may be confirmed by chemical and microscopical examinations are solicited. We don't want your practice, but we want the work that you may not have facilities or apparatus for. Send sputum in a clean, wide-necked bottle (as a 1-dram morphine bottle), prepaid by express, accompanied by a two-dollar bill, and it will be examined for tubercle and other bacilli, and a report made at once. Send the suspected urine, about four ounces, well corked, prepaid by express, accompanied with a two-dollar bill, and it will be immediately analyzed and report made. Write your name on the wrapper of each bottle. Address The Regular Medical Visitor, 224 M & J Building, St. Louis, Mo.

THREE HUNDRED POUNDS OF COW'S EXCREMENT CONSUMED DAILY.—Professor Conn, of Wesleyan University, is a discussion on the subject of dairy bacteriology, made the statement that the ordinary sediment from milk, when observed through the microscope, is found to consist of sticks, insects' legs and wings, hay, blood, and pus ; in fact, almost everything possible in the way of dirt, a large part of it being excrement. It has been estimated that N. Y. City consumes, daily, 300 lbs. of cows' excrement.

ACTION OF COLD ON BACTERIA.—Bacteria possess extraordinary powers of resisting cold. Thus Pictet and Young exposed cultivations of anthrax bacilli to a temperature of —76° C. for twenty hours without destroying their vitality, and similar results were obtained by Colemann and Mickendrick, who found bacteria to be capable of developing after being exposed to temperatures of —6° to —130° C. Yet, although cold does not destroy micro-organisms, it prevents their development, so that putrefactive bacteria remain quiescent in frozen meat. There are, however, certain nonputrefactive bacteria which can develop on meat which is kept only at 0° C. instead of several degrees lower. To this cause Lafar attributes the unpleasant flavor sometimes acquired by meat which has been kept for several days in an ice-chamber. This has been confirmed by Popp, who states that in cement-lined storage chambers the walls when moist swarm with bacteria, which when grown on beef-gelatin produce a mouldy flavor, and he considers these to be the cause of the objectionable flavor occasionally developed in stored meat. Flesh which has once been frozen is liable to decompose more rapidly than fresh meat, since bacteria can more readily penetrate the loosened intermuscular tissue.

BIOLOGICAL NOTES.

ATOMS.—The Popular Science Monthly for August opens with an article entitled "On Bodies Smaller than Atoms," by Professor J. J. Thomson, the successor of Lord Rayleigh and Maxwell in the chair of physics at Cambridge, who here describes for the first time in popular language the discoveries that have made him the leading living physicist. It seems almost incredible that he should not only have discovered but also weighed bodies smaller than atoms. Indeed most of our ideas are upset by this article. We are, for example, told that the elements are all made out of particles of the same kind, and that Franklin was right in calling electricity a fluid. There are not many outside the ranks of professional students of science who appreciate how completely ideas regarding the constitution of the world have been altered by recent discoveries in electricity. We all know that the applications of electricity have become dominant in the affairs of daily life, and a few years ago the X-rays attracted general attention. The X-rays are a mere corollary to the propositions of recent electrical research. Professor Thomson by his brilliant experiments in the Cavendish Laboratory of Cambridge University has proved that electricity is carried by minute particles much smaller than atoms and that these corpuscles, as he calls them, are split off from atoms. The atoms of the different elements are all made of the same kind of corpuscles. The minuteness of an atom may be appreciated when we learn that if the atoms in a pea became as big as a pea, the pea would be as big as the earth. It is certainly marvelous that bodies smaller than an atom can be measured.

MICRO-ORGANISMS IN COAL BEDS.—A rich source of fossil micro-organisms is the various Paleozoic flints that occur in certain coal basins and other deposits. It was from such that Brongniart described so many remarkable seeds and fruits of Carboniferous plants, chiefly from the basin of Saint-Etienne. They contain all manner of vegetable tissues, and M. Renault finds these permeated with bacteria and fungi. The silica has preserved everything with great exactness and the illustrations of microscopic organisms in this matrix are much clearer than those from the fossil combustibles. Some of these are older than the coal measures and are found in the Culm and even in the Devonian, as those of the Cypridine schists of Saalsfield, in which silicified remains of Cordaioxylon are affected by a Micrococcus (M. devonicus). At Estnost, near Autun, the roots of a Lepidodendron have the eggs of an insect or arthropod.—*Popular Science News.*

RED RAIN.—Captain C. J. Gray, collected a small quantity of material after a heavy fall of rain on December 28, 1896, in Melbourne, Australia. I have had the material mounted, but the quantity which I received did not contain the variety of matter that some other correspondents have noted. Observed by transmitted light, there were few characteristic particles, but with the aid a polariscope I was able to detect some small crystalline fragments of the nature of quartz, etc. It seems more than probable that the phenomenon arose in consequence of one of those heavy winds which have been known to carry dust from the Sahara as great a distance as 500 miles, and which in this case may have passed over some sandy tract in a like manner. The material has all the appearance of such dust. There are some interesting references to falls of red rain in P. H. Gosse's "Romance of Natural History," but none of them are of the same nature as the dust at present under consideration.

MICROSCOPICAL SOCIETIES.

Quekett Microscopical Club.—The 388th meeting was held on Friday, June 21. Amongst the additions to the library announced was a bound copy of Mr. E. M. Nelson's collected papers on microscopy and optics, presented by the author, for which a very cordial vote of thanks was passed. Mr. T. J. Davis exhibited a new cover-glass holder he had devised mainly for use in bacteriology. Mr. John Shephard, of Victoria, gave a most interesting account of the pond-life in that colony, so far as it had been investigated, and pointed to the extreme rapidity of development after the rainy season set in. He exhibited a new Brachionus under the microscope, and also, preserved in tubes, large colonies of Lacinularia striolata, etc., Lepidurus australis, and other forms. Prof. Hartog described the pecular method of feeding in the common Daphnia, and a successful way of staining and preserving translucent organisms like Branchipus in paraffin. Mr. R. T. Lewis read a further note on Ixodes reduvius, and exhibited a stained preparation of the spermatozoa. Mr. Walter Wesché read a short paper on a new male rotifier, Metopidia solidus, accompanied by drawings. A preliminary paper on the "Microscopic Structure of Metals and Alloys," by Mr. Sidney Smith, was read. Votes of thanks were passed for these several communications, and the proceedings terminated. The The informal meetings of the club for conversation and the exhibition of objects will be held on the first and third Fridays in July, August, and September.

NEW PUBLICATIONS.

"*The Microscopy of the More Commonly Occurring Starches.*" By Professor Hugh Galt. (Bailliere, Tindall & Cox.) Illustrated. This is an unpretentious little volume which aims at giving the analyst, student, and others who may have to examine materials for adulteration, etc., a basis on which to work. For this purpose a number of photographs have been taken with the aid of a microscope and reproduced in the book with the magnifications in diameters exactly stated. Starch grains are peculiarly unsatisfactory subjects from a photographic standpoint, and the internal markings by which the student is usually directed do not appear conspicuously in the photographs used.

We are not sure the aqueous medium that was used for the specimens is the best mountant, and we have often found that the details of such subjects are better displayed in some media than in others. Still the basis for working and deductions are sound, the contours, and sizes of the various starches are at once apparent, and these, after all, are the principal features which must guide any comparisons or examinations. We believe that the book will be found an extremely useful one to those interested in the subject and possibly to microscopists generally, for starch grains are easily secured, and there is considerable interest attaching to their examination.

MOSSES WITH A HAND-LENS.—Printed on excellent paper copiously illustrated (8 full-page plates and 44 figures inserted in the text), with new and artistic drawings from nature. No old text-books illustrations, complete glossary, Two easy and accurate keys, one based on habitat, the other on structure. It makes the study of mosses as easy as that of the flowering plants. Price $1.10. "Even at this day I can vividly recall my experiences when I began the study of the mosses, with no one to go to for assistance, and no book available except Lesquereur & James' Manual. Had such a book as Mosses with a Hand-lens been then accessible, it would have saved me many disappointments, not to speak of the loss of much valuable time. I can therefore most cordially commend this work to the attention of beginners and amateurs as being not only the best, but the only one of its kind, and as being admirably suited to render the assistance they need." G. N. BEST, M. D.

MISCELLANEOUS.

An Astrology for Doctors.—By Alpheus. 217 pp.12 mo. Until within a century, physicians always used astrology and they used it more than all other people, but astronomers used it also. The great Kepler used it and was nonplussed because he failed in an attempt to predict the death of Wallenstein. The position of Uranus is now said to have caused it, but Uranus had not been discovered in Kepler's time and had to be left out of his calculations. One of the most eminent physicians of Boston secretely uses astrology and told this author during the first hour of acquaintance with this author, then totally ignorant of the subject, that he would become a leader in astrology. This book in small compass, opens the whole subject, is beautifully bound and will be sent with the Microscopical Journal of 1901 for two dollars. You cannot afford in ignorance to ignore the matter.

Sea-weeds.—Tabulæ Phycologicæ by Fr.T.Kuetzing, in 19 volumes and index, has 1900 finely colored plates and sells for $500. A Leipzig book-seller, whose address we can give when requested by postal card, has undertaken to reprint volumes I-V, which alone are out of print, so as to sell complete sets for $125. provided a certain number of orders appear. Kuetzing's unique work is the greatest in existence on this subject and is indispensable for the study of sea-weeds. Our readers should seek to influence wealthy libraries in the U. S., to supply our country with at least a few copies, We are taking the orders for it in America.

Write to this Journal for circular.

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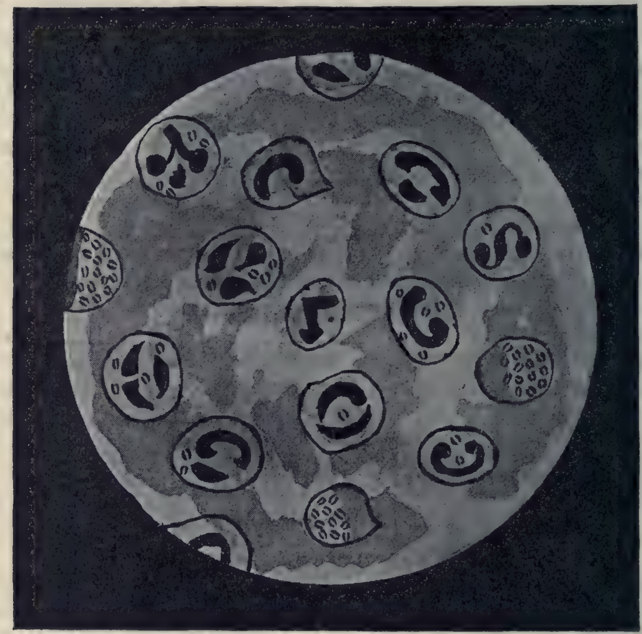
Comparative Treatment of Gonorrhea.

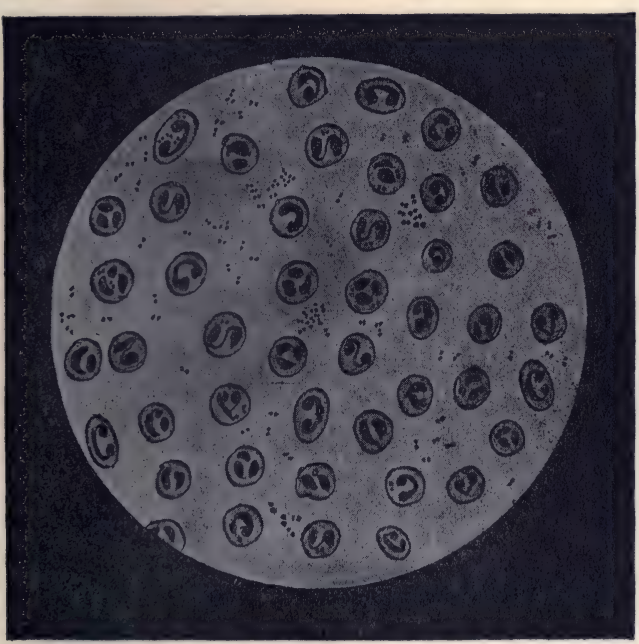
L MIDY, PARIS.

The various pathogenic bacteria, which are capable of producing disease, are of two varieties, the bacilli and micrococci. The latter are known as pus formers or bacteria, producing suppuration. Amongst them are the three different staphylococci, three different streptococci and the diplococci. To the latter class belongs the gonococcus of Neisser. The peculiar feature of this coccus is its biscuit shape, small and flat, in pairs, has no flagellæ and is motionless. It is found within pus cells or attached to epithelium. It does not grow in the ordinary culture media, but requires a special medium for its cultivation. If inoculated into the peritoneal cavity of animals, it gives rise to suppuration. All urethral inflammations are not caused by the gonococcus, and even in true gonorrhea all of the inflammatory symptoms do not depend upon the gonococcus, as the epithelial denudation following the disease permits the entrance of the common pus cocci of the urethra into the peri-urethral tissues. The peri-urethral abscesses and salpingitis, etc., not infrequently depend upon the ordinary pus-cocci and cases of gonorrhea with double orchitis and general septic infection with endocarditis have happened in which the gonococcus played no role in the sepsis, which was found to be caused by a large dumb-bell cocus, which stained beautifully by Gram's method. Hence the difficulty of making a positive diagnosis of urethritis attributable to the gonococcus.



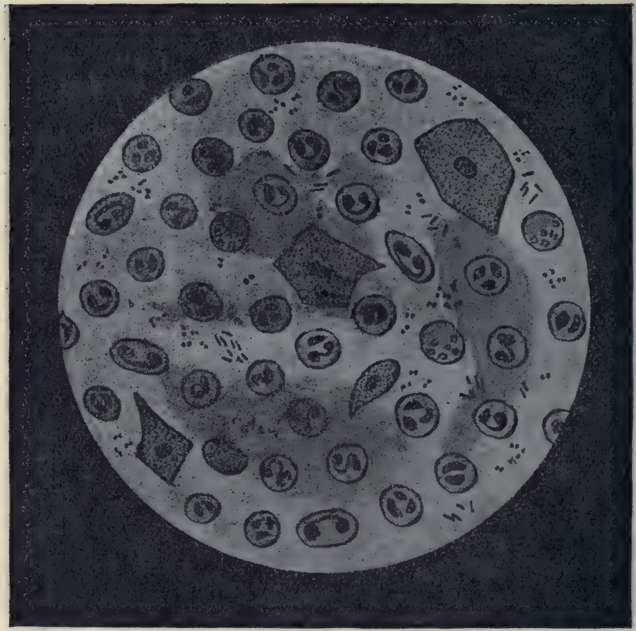
Gonoeoccus of Neisser, from pus of a gonorrheal patient before treatment.

Urethritis may be due to diathetic conditions, to chronic urethral discharges, to morbid states of the urine (cystitis), to sexual abuses, to dietetic excesses and irregularites, or alcoholism. In urethritis the inflammation is generally most marked in the anterior portion of the canal, but in the severe types it involves the entire canal down to the bulbo membranous junction or extends to the posterior urethra. The infection may extend from the meatus to the bladder. The treatment of urethritis comprises many methods, but it is seldom treated upon sound and rational therapeutic principles. The abortive treatment frequently resorted to has often led to serious consequences and is frequently employed by the patient prior to consulting a physician, while the rational or methodical treatment is seldom applied until urethritis is well established.



Urethrococcus(magnified 1500 times), common pus cocci of the urethra.

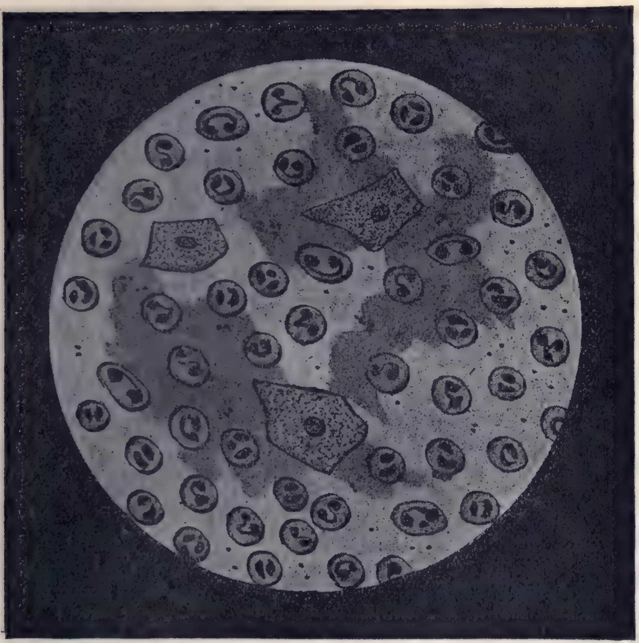
In metritis, Neisser's gonococcus is capable of penetrating the muscular tissue from the endometrium and there causing inflammation which may proceed to the formation of abscesses. The gonococci may remain for years in mucosæ, but the uterine muscular tissue is not a favorable soil for their propagation. Physical and sexual rest are the first important principles, after which come regulation of diet and internal medication. Sandal wood oil is successfully used in gonorrhea and inflammatory diseases of the mucous membranes due to pus formation, but aside from this, little is known of its physiological action. The best sandal wood oil is that made by Midy's process from Mysore wood, on account of its rapid and continuous resorption into the blood. Gonococci have also been found in acute joint inflammations (gonorrheal arth-



Case A (magnified 1500 times), showing results of one week's treatment with irrigation and permanganate injections.

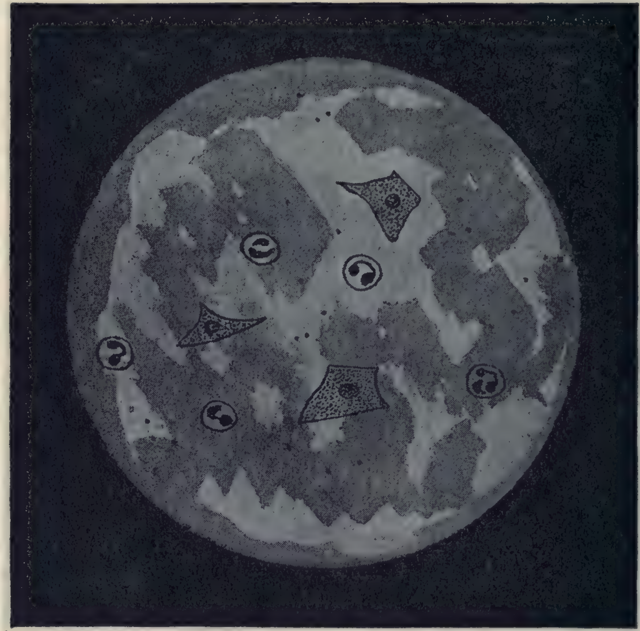
ritis),which is frequently followed by ankylosis, and the early and continued use of Santal Midy will prevent such sequelæ.

Reliable data derived from continuous urine examination of three gonorrhea patients under proffessional observation, placed upon the same diet, rest, etc., but under three distinct methods of treatment, will serve to illustrate the anti-bacterial properties of sandal wood oil, as compared with local treatment and other anti-gonorrhea remedies.



Case B (magnified 1500 times), showing results of one week's treatment by irrigation, injections of nitrate of silver and alkaline diluents with copaiba and cubebs.

Case A.—Age 36, gonorrhea (microscopically demonstrated), eight days' standing. Discharge thick purulent pain near meatus upon urinating. Examination of urine reveals: spec. grav., 1016; react., alkaline; trace of nucleoalbumin, no sugar or bile. Excess of earthy phosphates, pus cells, triple phosphates, squamous epithelium, gonococcus, micrococcus ureæ. Treatment: Irrigation twice weekly and injection t. i. d. with one in four thousand sol. potass. permang. One week from beginning of treatment, no changes excepting decrease of the pus cells, discharge watery, gonococcus still present.



Case C (magnified 1500 times), showing results after one week's treatment with Santal-Midy only.

Case B.—Age 27, gonorrhea (microscopically demonstrated), seven days' standing. Discharge thick greenish, pain when urinating. Examination of urine reveals: sp. grav., 1016; reaction, slightly acid; no sugar, albumen or bile, few uric acid crystals, squamous epithelium, pus cells, few leucocytes, gonococcus, urethrococcus. Treatment: irrigation twice weekly and injection morning and night, of one per cent sol. argent. nitr., also alkaline diluents, copaiba and cubebs. One week from beginning of treatment, general condition improved; there still remains, however, a continuous watery discharge from urethra. Microscopically, micrococcus ureæ; streptococcus still present.

Case C.—Age 29, gonorrhea (microscopically demonstrated), ten days' standing. Has been using injections; purulent greenish discharge from urethra, severe pain while urinating. Urine examination reveals: spec. grav., 1018; reaction, neutral; no albumen, sugar or bile; triple and earthy phosphates, squamous epithelium from the bladder and urethra, pus cells and few eosinophiles, gonococcus, micrococcus ureæ, streptococcus. Treatment: two capsules of Santal Midy every two hours. One week from beginning of treatment patient feels well, has had no digestive disturbances. No discharge from urethra excepting upon forced pressure a small watery drop, which under microscope exhibits flat epithelium, earthy phosphates, and a few micrococci ureæ. A series of experimentations on these lines gave like results and led to the following deductions regarding the physiological action of Santal Midy. This drug appears to act as an internal antiseptic and as an astringent to mucous surfaces, checking secretions. It is excreted by the kidneys and imparts an oder to the urine, giving the latter medicinal qualities, thus acting on the urinary passages. It is rapidly absorbed and eliminated, which is proven by its detection in the urine one-half hour after its administration. Part of the Santal Midy escapes by the broncho-pulmonary mucous membrane, where it exerts excellent local effects in chronic bronchitis.

Essential oil of sandal has been severely tested by Mr. Henderson of Glasgow, Posner of Berlin, and in France by Dr. Panas of the Hotel Dieu Hospital, Professor Gubler, Dr. Simonnet and others, in all cases where copaiba and cubebs are generally prescribed.

The objections to copaiba and cubebs are obvious, especially in the usually strong doses necessary under the circumstances; they give rise to repulsive eructations, gastro-intestinal disturbances, vomiting, indigestion, diarrhea and besides the urine and breath are loaded with disagreeable and characteristic exhalations, and the body frequently becomes covered with eruption. Henderson asserts that he always found *pure* sandal oil inoffensive even in large doses, and that at the expiration of forty-eight hours great relief is effected. Besides it has the important qualification of pleasing the patient and being agreeable to the stomach.

In a communication to the Paris Medical Society, Dr. Panas also advocated its use. "*Pure* essential oil of sandal modifies the inflammatory symptoms of gonorrhea in a very striking and rapid manner, by removing the scalding in the urethra in a short space of time, varying from one to three days; its most remarkable action, however, is that which it exerts on the discharge, the nature of which is changed in the course of twenty-four to forty-eight hours at the utmost, becoming at first reduced to a species of intermittent serous dripping, which is diminished to a few drops of whitish muco-pus and then totally disappearing, whatever may have been the color and abundance of the secretion before the treatment."—*St. Louis Medical and Surgical Journal.*

Cleaning Desmids.

Dr. G. H. Bryan contributes to the "Journal of Applied Microscopy" a method of cleaning desmids from the dirt and flocculent matter with which they are commonly mixed. The requisite apparatus consists of one or two shallow porcelain saucers or photographic dishes, an old pomatum-pot, and a stylographic or fountain pen-filler, together with also the gauze strainer of a coffee-pot with which to strain out large pieces of dirt. The material is strained into one of the porcelain or other dishes, and after an interval of not more than half a minute the dish is inclined to one side, a gentle rocking motion being given at the same time. Any desmids will collect in a bright green line or patch at the edge of the receding water, from which they are picked up by means of the pen-filler. By working the water round the edge of the dish the desmids may be drawn into green patches in almost any desired part of the vessel, and one lot after another picked up until there are none worth troubling about. As the desmids are removed they are transferred to the pomatum-pot, where a drop of Zenker's fixative suffices to fix them. Zenker's fixative is made up of 5 per cent of sublimate and 5 per cent of glacial acetic acid dissolved in Muller's solution, which is itself composed of two to two-and-a-half parts of potassium bichromate, one part of sodium sulphate, and a hundred parts of water. A repetition of the rocking process enables the desmids to be again collected, taken up with the filler, and transferred to a dish of clean water, being deposited in a patch near the edge of the dish. This latter is again rocked to wash away the fixative, together with any foreign matter that has survived the previous process. The desmids should be again transferred to clean water to ensure the removal of any trace of fixative, and if they are to be stained the stain can be washed away in the same manner. This method of washing involves less loss of specimens than the ordinary decantation method, providing that care be taken to deposit the desmids as close together as possible after each transference; whilst the process does not take more than from half an hour to an hour, so that the fixative has not time to injure the color of the specimens. If much foreign matter—*e. g.* peat—is mixed with the original gatherings, the whole may be left in a wide-mouthed bottle in the light for a day or two, when the desmids will collect on top of the sediment, where they will increase and multiply. The surface layer containing the desmids may then be drawn off with a syphon and cleaned as before. A somewhat similar rocking process is useful for separating foraminifera from sand, but the rocking must be a little more violent, when the sand is left behind, unlike the flocculent matter in the desmid gatherings, which is swept forward by the water. The foraminifera are not, of course, so easily distinguished by the eye. In mounting, Dr. Bryan makes a small box of parchment paper, about 1½ inch by 1 inch, and places the water containing the desmids in the box, which is then floated on glycerine. In two days the water will have diffused into the glycerine, and sufficient glycerine to penetrate the desmids will have passed through the parchment into the box. By this ingenious method the desmids will undergo no contraction.—*Science-Gossip.*

Mounting Marine Algae.

JOHN T. NEEVE, DEAL, ENG.

I submit the following few notes on preparing and mounting marine algae, which originally appeared in the "International Journal of Microscopy and Natural Science" in October, 1894, hoping that they may induce some to take up the study of these beautiful lowly plants.

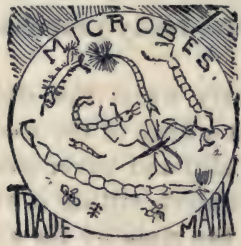
I will assume that we have collected a number of different species, either from the seashore after a breeze or from the rocks at low tide; as soon as possible on reaching home we proceed to examine our treasures. Have ready a couple of basins, a soup plate, and a couple of saucers; put into the basins and plate some sea water, or salt and water made by well stirring some common salt in a jug of fresh water; let it settle and then pour off. Wash the algae well in No. 1 basin and rinse in No. 2, carefully spread and float out the frond in the plate, and examine with a lens. Any tips or branches of the frond that we see have fruit, and any of the smaller algae we will examine under the microscope by floating them on to a glass slip, 3 in. by 1 in.; the larger mass we will float out on paper as an herbarium specimen. Having detected those pieces bearing reproductive organs, etc., which we desire to mount as microscopic objects, we place them in a saucer with clean fresh water, and after a few minutes float a portion on to an ordinary 3 in. by 1 in. slip, and after removing it from the water we dry it with a linen rag, wiping off the water, and with a piece of blotting-paper soak out all the water we can from the algae. Have ready your clean cover-glasses and medium.

Now you can gently warm the slip with the piece of algae on it, and put a drop of the medium on to it; then, again warming the slip and cover-glass, place the latter carefully on to the object, tilting it on so as to drive out any bubbles. Lay the slide by for a few hours until the medium is set (it may remain several days); then, if satisfactorily done, clean off all the superfluous medium with sponge and warm water, ring it first with gold size and then with white zinc cement, finish with a named label, and we have a slide worthy of a place in any one's cabinet.

I have always found Deane's medium to be the best for preserving the color and structure of the cells. It is made as follows:—Gelatine, 1 oz.; honey, 5 oz.; water, 5 oz.; rectified spirit, ½ oz.; creosote, 6 drops. Soak the gelatine in the water until soft, add the honey, then boil the mixture. When it has cooled somewhat, the creosote mixed with the spirits is added. Lastly, filter through fine flannel. The medium is used warm. I have tried glycerine jelly, and discarded it on account of its dissolving all the color out of the algae. Canada balsam is useless, as the object must be dried, thus shrinking and distorting the structure of the cells. In Deane's medium we have the material which, so far as my experience goes, is most suited for these beautiful weeds.—*Sci.-Gos.*

A New Discovery in Microbes.

Through the kindness of G. W. Walters of Findlay, O., who has loaned the cut, we are able to present a view of "One drop of water magnified 5,000 times." He uses this as a trade-mark of his "Anti-microbe formulas." He has an office and laboratory at 1639 North Main st., Findlay, Ohio. The four formulas which he sells are (1) Electro-prophylactic and currative for all ailments caused by disease germs; (2) all lung troubles and cures nine cases out of ten; (3) positive cure for leuchorrhœæ, spermatorrhæa, "enlarged prostrate," impotency, stricture of the rectum and painful menstruation; (4) Will dispell all the poisonous amœba from blood and membrane of head, throat and vagina. He also sells a box of his "germacide compound" that will ozonize 16 quarts of the best anti-germ solution ever was known. You get it all for two dollars, less one dollar if you mention this Journal.



As he is short of capitol to push this business, he will supply formulas, compound and instructions to agents and allow them half the profits.

As microscopists we are especially interested in this cut and the un-named forms pictured therein. With our best powers and completest apparatus we have never seen any of these forms in a drop of water. While stagnant water does contain certain forms (different from the "microbes") all microscopists seem agreed that water we drink contains no forms at all. If any scientist, doctor or amateur has ever seen any of these forms under 5,000 times magnification we shall be pleased to assist Mr. Walters in his business. He has not yet informed us when and where he saw them.

Notes on Microscopy.

M. I. CROSS.

THE HELIOSTAT IN MICROSCOPY.—They who have never seen the microscope used in conjunction with a heliostat have yet to learn the possibilities and advantages of such a form of illumination.

Residents in bad climates have substantial excuses for not using the heliostat because of the uncertainty of getting bright sunshine at the time of working; still the intermittent occasions on which it could be employed well repay them for their trouble.

Microscopists with leisure would find it more useful than those who have few opportunities of working in the day time, while those who live in countries where continuous sunshine can be depended upon are strongly recommended to make trials of a heliostat.

Its advantage is especially indicated in the illumination by monochromatic light, for which purpose two right angle prisms of dense glass with about 1¼ inch face are necessary, with half a rapid rectilinear lens to concentrate the light upon the prisms and the remaining half placed to receive the spectrum as it emerges from the prisms.

The microscope should be placed at some distance, say 12 to 15 feet, from the prisms, the height of the heliostat being so arranged that the beam from it shall fall upon the microscope mirror. A strip of card should be set in front of the microscope on a level with the mirror, and the room darkened as much as possible, when it will be found, if the prisms are nicely adjusted, that a brilliant image of the spectrum is projected. By slightly moving the prisms or the microscope, the exact wave length of light that is desired for the work in hand can be selected, and that wave length used for the examination or photography of objects. The brilliance of illumination secured under these circumstances is so great that light well into the violet end of the spectrum can be satisfactorily utilized, and the resolving power of objectives increased thereby.

No ordinary light filter passes light of one wave length or even approximately so; by means of a heliostat a far more exact result can be secured, especially when by the method named above, a spectrum measuring 20 inches or more in length can be obtained at the microscope mirror. Those who worked with a heliostat once will anticipate further sunny hours for improving their acquaintance with it.

Labelling Specimens.—It is well in mounting objects to have some ready means of marking them for future identification. The so-called grease pencil for writing on glass, which may be had in various colors, and can be purchased from many opticians, is one of the handiest and neatest means, especially as the writing can be removed subsequently with a little warm water.

Another device where labels are not at hand is to pass the glass slip across the tongue, allow the dampness to dry, after which an ordinary pen and ink can be used for writing upon the portion so treated.

In the case of specimens mounted on cover glasses or slides, which it is required to identify after passing through various solutions, the following method is recommended :—

Mix into equal parts of egg, albumen and glycerine, sufficient lampblack to make a good black fluid; this may be used with a steel pen for writing on a cover glass or slide, after which the glass should be held over a flame until the characters are dry; glasses so treated will not lose identification marks if placed in solutions.

PHOTO-MICROGRAPHY.—Workers with limited means are often tempted to try this process but are appalled by the number of fittings usually specified as necessary. It has to be borne in mind that not everyone is bent on performing feats of resolution of diatoms or working with high powers. In making observations, there are numerous enthusiastic amateurs, who, seeing a striking feature in an object, desire to record the appearances by photographing it for future reference or for the edification of friends. The majority of such work would come within the scope of 1″ or ½″ objectives, and many of the ordinary fittings of complete photo-micrographic cameras are not really necessary, however desirable they may be.

What is the simplest apparatus that can be used?

Being provided with a microscope and bull's eye, the additional apparatus would consist of a lamp, some form of camera, a support will carry the camera at the axis height of the microscope when set horizontally, and a tube to connect the front of the camera with the body of the microscope.

1. *The Lamp.*—This need not be of an expensive kind such as is ordinarily supplied for microsopical work. One with a tin frame which is purchasable at an oil shop for 25 cents answers very well. 2. *The Camera.*—This should have not less than 10″ of extension and requires to have a good dark slide with it. The focussing would, of course, be done by means of the microscope adjustments. 3. *The connecting tube* might be of cardboard or of brass as preferred. 4. *A support for the Camera.*—This is really of great importance in an arrangement of this kind. It would be well that a frame should be shaped

up by a carpenter to which the camera could be attached and on which, at a suitable level, the microscope and lamp could be placed in a fixed central position.

A knowledge of photography is so general that it is hardly necessary to say that an acquaintance with developing, printing, etc., is desirable; but with such contrivances as those named, carefully arranged, really good results can be secured with low-power objectives.

Success under such circumstances will lead to a desire to attempt more pretentious work with better apparatus. Photo-micrography has a charm of its own, but in order to attain proficiency it is essential that the worker possess a good practical acquaintance with microscopical manipulation and ordinary photography. The failures that are so freqnently met with are due in the majority of instances to ignorance of one or both subjects, in fact, the writer has met with people who have essayed to do photo-micrography without previous serious work with the microscope or knowledge of its limitations. A serious practical man can succeed with elementary arrangements where a novice with the best equipment of apparatus would fail.

Low-Priced Objectives.—Perhaps in nothing so much as in scientific work is the fear present that anything that is low in price is likely to be poor in quality and yield corresponding results. But it can be claimed that this does not apply to microscopical objectives.

The past decade has seen a wonderful forward movement in the construction of these lenses. The almost general use of the microscope in laboratories, technical schools, for manufacturing purposes, and even in primary schools, added to the increasing recognition of its value as a means of recreation, has created a demand which has been at all times a critical one. A few have always been quick to recognize the merit in lenses and to make their virtues known. The manufacturers have vied with each other, and by the use of the many optical glasses that are at their disposal, combined with extensive computations and experiments and skilful work, they have produced lenses of large aperture and fine performance. When apochromatic objectives were first introduced their performance was in the majority of cases immeasurably superior to others. These have been taken as a standard, and many lenses at very low cost are being made that are practically equal to them excepting only so far as the color corrections are concerned.

It must not be inferred that this point is neglected, in fact it requires a critical eye oftentimes to detect an inferiority in this respect, but for the bulk of the work undertaken by microscopists it can be disregarded, and the cheaper lenses will reveal all that the apochromatics are capable of showing. These remarks apply to the products of nearly every firm of repute, and advice would be willingly given by such in the selection of lenses, which could be accepted without misgiving.

CONDENSER.—The reason why a condenser having a smaller aperture than that possessed by the objective is sufficient is because there are no lenses available that will bear an illuminating cone equal to their own aperture. As a rule definition begins to fail even with the best lenses when anything more than a cone of three-fourths the numerical aperture of the objective is employed. There have been exceptional lenses which have borne more than this, but they are rare. It would be well worth your while to have an oil immersion condenser if you were using an objective with a N. A. of 1 40, It is possible that this lens would stand a cone slightly in excess of 1·0 N. A., and the best dry condensers do not give more than ·9. The cone of illumination required depends in a large measure on the subjects that are under examination; for a large amount of work a cone of ·9 would be quite sufficient for a lens of 1·40. Directions for the regressive staining methods are contained fully in the "Microtomist's *Vade Mecum*," by Lee. Several pages are devoted to the subject. The process could not be briefly described in these columns.

CELL CONTENTS.—When it is desired to show the contents of cells and vessels in woods, the sections must be cut, and mounted, dry. The best tools for making large sections of hard wood, are a carpenter's bench and a good plane. Longitudinal sections of almost any size can be cut in this way, and they can be trimmed up and the ends cut square with a pair of scissors. Then, if desired, they may be soaked in water and mounted in glycerine jelly. If the cell contents, viz., oils, turpentine, or resin are required to be shown, the sections must not be placed in alcohol because it would dissolve such contents; they consequently cannot be mounted in Canada balsam. I do not know of any microtome that will cut transverse sections of hard tissues of a large size. The one referred to—Cole's pattern—is a very good one, but I am afraid that paraffin would not do for embedding, especially in India; a good firm piece of carrot is the only thing I know of. For instructions in staining and mounting, I would recommend Lee's "Microtomist's *Vade Mecum*," and for practical botanical histology Strasburger's "Practical Botany."—*Knowledge.*

Notes on Microscopy.

F. SHILLINGTON SCALES, F.R.M.S.

MICROGRAPHIC FLY CAGE.—The "Journal of the Royal Microscopical Society" describes and illustrates the apparatus exhibited at the meeting of the Society on February 20th, devised by Mr. G. H. Rogers, and made by Mr. C. Baker, of High Holborn, for exhibiting the proboscis of the common house-fly as an opaque object. It is large enough for the blow-fly, but can be made of any size. It consists of a brass cone soldered to a brass plate with a hole in it, just large enough to admit the head of a fly, which is surrounded by a disc of ivory set into the plate. The fly is gently pushed into the cone with a little piece of wool behind it, and is ready for examination. A little treacle or honey is put on to the ivory disc; the fly puts out its proboscis, which is kept flat and in one position. It is very easy to focus, and requires no more adjustment of the object than an ordinary slide.

MITES IN MICROSCOPIC SLIDE.—I have a slide of a portion of the polypary of a Californian zoophyte (*Membranipora tuberculata*) mounted as an opaque object for top-light. It is in a cell which is securely sealed by an ornamental paper with an opening to show the object, but otherwise covering the 3 x 1 glass slide thoroughly and effectually, the object being hermetically sealed. I have no record of the preparer, except that it is not my own work. The slide has been in my cabinet for certainly not less than ten years, and, until a day or two since, for a very long time I have not seen it under the microscope. On this occasion I had it under the 2-inch and brilliantly lighted by the side-reflector, when some moving object in the cell caught my attention. This moving, living object proved to be a mite, which was active and vigorous, and, so far as I could examine it, resembled the cheesemite (*Tyroglyphus domesticus*). It was not alone, for I quickly discovered another, equally lively, and on looking closely I found two exuviae and what looked like portions of others. The object in which these mites have been carrying on their life-histories is about 3-10th of an inch square, and presents on the surface 360 thecae, or cells—a sufficiently big world for two or three organisms so tiny—but whence came they, and whence their supply of oxygen and food? These are questions which puzzle me.—*F. R. Brokenshire, Exeter.*

[If we understand our correspondent aright, the cell is a dry one, and the cover-glass is held in place only by the paper covering the slide. The cell would therefore not be hermetically sealed. The mite referred to may be *Tyroglyphus entomophagus* or *Cheyletus eruditus*, the book-mite, both of which are not uncommon unfortunately in museums and collections, where they feed upon the specimens, causing much havock. *Cheyletus* can be distinguished by its large raptorial palpi, of which a good drawing appeared in Mr. Allen's "Journal of Microscopy," 1893, p. 100. There is a drawing in the "Micrographic Dictionary," but it is not accurate.—*Science-Gossip.*

Extracts from Postal Microscopical Society's Note-books.

Edited for Science-Gossip.

PARASITE OF GOLD-FISH.—This is a most voracious little creature. As often as I removed him from his host he swam directly back again, and it was only with great difficulty he could be dislodged. The chief place of attack seemed to be about the shoulders. At the time I caught this parasite I was very much engaged, so I sent it to a professional mounter in London to be mounted, asking at the same time for any information he could give me on the creature. He said he had similar ones from the Brighton Aquarium, but could not tell me anything more. It is a singular creature, possessed of numerous ciliated swimmerets; but perhaps its chief feature of interest is the means by which it fastened itself to its host. These will be seen at the anterior end in the shape of two powerful suckers, around which there seemed to be a large number of radiating ciliary muscles. There are also two singular organs of a triangular shape not far from the suckers, apparently of a chitinous substance. I should be glad of information on this parsite. —*R. T. Ditchfield.*

This parasite is *Argulus foliaceus.* The following description is from the "Micrographic Dictionary": "A genus of Crustacea, of the order Siphonostoma and family Argulidae. Characters: Carapace membranous, covering the cephalo-thorax like a shield; antennae four, short, concealed beneath the carapace, anterior two-jointed, terminal joint hooked; posterior four-jointed; rostrum acuminate; five pairs of legs, the place of the first (6th) pair being occupied by two suckers; second pair short, five-jointed, the two basal joints spinous, the last joint with two small hooks; the last four pairs of of legs two-cleft, and furnished with ciliated filiform processes." The *Argulus* is usually found parasitic on fresh-water fish, and is often called the "fish-louse."—*C. Folkard.*

This is certainly *Argulus foliaceus.* It is a very old friend of mine. I took a careful drawing of one some time ago. I have fallen across this parasite several times since. *Science-Gossip* gave a figure of one some years ago, which was afterwards reprinted in Taylor's "Half-hours in the Green Lanes." It is found on all kinds of fresh-water fish, and Taylor says it is also found on the tadpole.—*Chas. D. Soar.*

There is an illustrated article on "Fish-lice," by Mr. F. Noad Clark, at p. 324, S.-G., Vol. V., N. S., describing the life-history of *Argulus.*]

MOUNTING ROTIFERS AND HYDROZOA.—I have never seen any successful mounts of rotifers. Can anyone instruct me how to do it? Fresh water is full of beautiful creatures, but we seldom see them preserved as slides. My method of mounting rotifers has been to drop one per cent solution of osmic acid onto the slide, and close the cell.—*William H. Burbidge.*

Mr. Burbidge's failure is fully explained by his having killed the rotifers too quickly. They require narcotising first and then killing at the right moment. This is Mr. Rousselet's method, as fully explained in the "Journal of the Quekett Club" for 1893, p. 205. I understand that this method has not been tried on polyzoa, but I think it is worth trying.—*J. S. Pratt.*

I have tried osmic acid with the fresh-water hydra, but only about one in a dozen is passable.—*J. Phillips.*

I have mounted hydrozoa with fully expanded tentacles quite successfully by the following method: Place them in a rather shallow vessel of sea-water and add, very gently, a few drops of chloroform-water by means of a pipette. At first the hydra will draw in their tentacles, but if too much has not been given they will expand them again. Then add a little more chloroform-water. After a while, under the influence of the anaesthetic, the animals will become apparently stupefied and cease to draw in their tentacles. Now is the time to kill them, and this is done by suddenly pouring over them a hot saturated solution of corrosive sublimate. This method does also for rotifers. They should be mounted, not in glycerine, but in balsam or weak corrosive sublimate solution.—*A. Montague.*

I once spent some time trying to mount rotifers, but with very little success. It is useless trying to fix them instantly with osmic acid. They require to be previously narcotised. The difficulty is to know when they are sufficiently narcotised for the application of the fixing agent.—*J. R. L. Dixon.*

PATTERNS IN GLYCERINE-JELLY MOUNTS.—Many years ago I was much troubled with the beautiful patterns produced by the vaporization of glycerine jelly. After spoiling a number of slides I decided to do no more glycerine-jelly mounts, but to keep to balsam. An earwig's wing which I mounted in the "eighties" kept very well till quite lately, and then went in this way. I wish some member would photograph this vaporized jelly; it is just like a wall-paper pattern, and every branch seems to join on contiuously. I have never seen a more beautiful example.—*G. H. Bryan.*

I have photographed the "vaporized jelly" as Dr. Bryan wishes. The narrow portion of the pattern is the jelly, and the wider part the vacuoles.—*J. J. Wilkinson.*

This beautiful and wavy pattern arises, I think, from shrinkage of the mounting medium, whether glycerine jelly or not I cannot say. I have mounted many objects in that medium, and have many now of some years' standing, but have never had a slide turn out like this. In my case the jelly has always filled up the space under the cover-glass, whereas in the present instance it only partially fills the space, the rest being air, so that there is room for expansion or shrinkage. This, however, is only my idea; and as Dr. Bryan has some slides mounted in jelly which have acted in a similar manner, his views of the cause may be the correct one.—*John Hibbert.*

CARMINE AND PICRO-CARMINE AS STAINS.—I would like to enter a protest against the use of carmine stain. One cannot get rid of the little particles of carmine that so plentifully bestrew the objects. It is the same with haematoxylin. The color is but mechanically suspended, whereas in picric acid and the aniline dyes the stain is chemical and leaves no deposit.—*Adam Clarke Smith.*

I am afraid I do not follow Mr. Smith's objection to the carmine stain. In the slide referred to there are to be seen abundant tissue nuclei stained deeply with carmine, and in places shreds of tissue that have become loosened during mounting; but I nowhere observe particles of carmine "bestrewing the objects." Carmine is certainly not a good stain for most animal tissues, being more serviceable for the nervous system and for vegetable sections. I find it, however, the most convenient stain to use for celloidin sections. Some of the sections would have been improved by a little longer treatment with acid alcohol. In my opinion there is no better stain for animal tissues than haematoxylin, and especially Ehrlich's ammoniated haematoxylin. I would rather part with all the other microscopical stains than this. I would suggest the use of this stain for animal sections in preference to carmine, together with eosin as a contrast stain. Carmine and haematoxylin are nuclear stains; picric acid is a plasmatic stain and cannot supplant a nuclear stain like carmine, but may be used after it or in conjunction with it, as in the well-known picro-carmine stain. The only disadvantage raised against haematoxylin as a stain is that it is thought not to be permanent. This may be the case with some preparations, but I have not found it to be so with Ehrlich's. The aniline stains, though permanent and capable when skilfully used of giving very fine results, and also of being very useful for special purposes, require care in their use, and are not very suitable to be put into the hands of a beginner. Further, they are quite unsuitable for celloidin preparations. I have used picric acid in conjunction with aniline blue as a nuclear stain, but the differentiation is not so sharp and the result not so good as that obtained by haematoxylin and eosin.—*J. R. L. Dixon.*

I have seen some very good slides prepared in Germany by injecting the the blood-vessels with a solution of gelatin colored, I believe, with cochineal. I have had some of the slides more than twenty years, and the color is good now as at the first. The condition of the epithelium of a mucous membrane can be readily seen, and this is important in some diseases.—*F. Bossey.*

The picro-carmine staining slides of the same tissue are interesting if put up with : (*a*) Picro-carmine and Farrant's solution; (*b*) picro-carmine and Canada balsam; (*c*) picro-carmine, followed by water acidulated with picric acid, a few drops being placed in a watch-glass of water. The results vary, and it is worth noting which come out best. Treble staining has a great future, and the extra trouble is well repaid. I have for some time worked at the latter, and find that a most beautiful combination to use is a weak solution of the carmine, ten drops in a watch-glass of water, followed by rosaniline, and finally by gentian violet.—*T. P. Thomson.*

MISCELLANEOUS.

COAL SECTIONS BLEACHED.—In reply to query on page 120, Dr. W. G. Reed sends us the following:

"The coal is macerated for about a week in a solution of potash; at the end of that time it is possible to cut tolerably thin slices with a razor. These slices are then placed in a watch-glass with strong nitric acid, covered and gently heated; they soon turn brownish, then yellow, when the process must be arrested by dropping the whole into a saucer of cold water, else the coal would be dissolved. The slices thus treated appear of a darkish amber color, very transparent, and exhibit the structure, when existing, most clearly. We have obtained longitudinal and transverse sections of coniferous wood from various coals in this way. The specimens are best preserved in glycerine in cells; we find that spirit renders them opaque and even Canada balsam has the same defect."—*Micrographic Dictionary.*

NECROLOGY.—Hans M. Wilder who was born in Iceland, in March, 1831, died in Philadelphia, January 25, 1901. An appreciative notice of him is published in the "American Journal Phar.," August, 1901. Mr. Wilder was a contributor to our work and known to some microscopists.

FESTIVAL.—The Natural History Society of Neuremberg, Bavaria, will celebrate its One hundredth Anniversary Octo. 26 and 27, 1901. An address will be given by the Director, Dr. Heerwagen, and the principal address will be by Herrn Professor Dr. Sigmund Gunther of Munich. There will be a reception in the Museum and a banquet at the Golden Adler Hotel.

MICRO-MATERIAL.—Wanted; fresh pollens, starches, diatoms, zoophytes, Coleoptera (good British or foreign), also sponge spicules or other interesting marine specimens. Must be correctly named. Send list and quantity. Liberal exchange given in either other material, mounted specimens, or microscopic apparatus.—M., 69 Park Road, Clapham, London, S. W.

Nutmegs.—A St Louis editor gives the microscope credit for having detected many food and drug adulterations including the Connecticut wooden nutmegs. Verily, the microscope seems to have done more than we supposed it had done.

Lepidoptera.—For exchanges, supplies, books, etc., see lists of J. W. Davis, 31 Hythe st., the Bridge, Dartford, Kent, England.

An Aversion to Micro-Science.

The person with a microscope, he's always hanging 'round,
And scaring everybody with his vision so profound.
If I had paid attention to the various things he said,
I'd surely be so frightened that I might as well be dead.
There isn't any limit to the deadly germs he'll spy
Whene'er he takes his lenses out and winks the other eye.
I might face the jungle tiger and imagine it was fun,
But this microscopic terror truly has me on the run.

He writes about bacilli who your tissues will explore,
Of the marching microbe millions who are searching for your gore;
He tells of the persistence of these ministers of death,
Till you nearly have a spasm every time you draw a breath.
He even gets up pictures of the surreptitious germ,
Who is solely in existence to cut short your earthly term.
And life is strangely bitter and devoid of any hope,
All owing to this croaker with his maddening microscope.—*Exch.*

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Protoplasmic Currents and Vital Force.

PROF. A. L. HERRERA, M. S. A.

I have lately stated that some currents of granules may lead to the formation of a pseudopodium in my synthetic protoplasm observed under the microscope.* What occurs, however, is an exact imitation of the natural phenomenon. The internal energy of the said currents expends itself in external movements. The fluid loaded with granulations strikes, as it were, a blow as it dashes against the endosarc, or the limiting membrane of the protoplasm, and pushes it outwards.

But these currents play a more important part; they induce, indeed, the following processes:—

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* *Natural Science*, August 1898; *Bull. Soc. Zool. France*, 1898, p. 119; *American Naturalist*, December 1898.

1st. Renovation of the surfaces of contact between the oxidisable parts and the external oxygen. More effective elimination of carbon dioxide.†

2nd. Conveyance of the nutritive particles and residues. Nutrition of the masses of alveolar protoplasm, which fulfill the functions of glands, etc., according to principles of Van't Hoff, Becquerel,‡ and Loeb. Circulation of the reserves and circulation in the zymoses.

3rd. Deposition of certain materials and separation of some others according to their solubility, density, and so forth. Concentric formations, incrustations, etc.

The study of these internal currents is, one may say, the chief aim of physiology. They may be explained in terms of known physico-chemical causes rather than by an undiscovered and undiscoverable vital force. The causes are—

A. Diffusion and osmotic currents.

B. Heat. Oxidations.

C. Ingestion of the materials that support the phenomena of diffusion and oxidation.

D. Partial vacua and changes of every kind in internal pressure, induced by evaporation, etc.

The action of these causes may be tested by both the natural and the synthetic protoplasm.

A. The use of gummy water is indispensable if one wishes to observe the circulation of protoplasm in the elements of trees, and the movements are generally dependent on the conditions of diffusion (cf. Butschli's foams).* The currents of the artificial product vary in accordance with diffusive power of the substances, the quantity of liquid, and the presence of some large granulations.

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† See A. L. Herrera and D. Vergara Lope, "New Theory of Respiration." Congress at Moscow, 1898.

‡ Becquerel, "Les forces electro-capillaires dans les phenomenes de nutrition." *Comptes rendus Acad. Sci. Paris*, 16 Fevrier 1875.

* See Milne-Edwards, "Anatomie et physiologie comparee."

B. The rapidity of diffusion increases, within certain limits, with an elevation of temperature (Graham). The movements of the protoplasm increase in rapidity between 10 and 22 degrees, becoming slower beyond those limits, and stopping betweeen 45 and 48 degrees.

I have seen that at a suitably high temperature these currents present themselves even in very viscous liquids. It is evident that oxygen as well as the liberation of heat attendant on respiration are equally necessary to every being.

C. The paralysis of artificial currents ceases completely with an addition of peptone or a new quantity of salts.

D. This is an evident principle. It is enough to remember the facts concerning the circulation of sap and blood. The paralysis of internal currents stops life every where, decomposition coinciding with an absolute diminution of movement.

The rapidity of the course of blood through the capillaries is identical with that of the currents of protoplasm and varies likewise according to conditions, its result being the same—nutrition and life.

A motionless peripheral layer of serum is observed similar to that apparent in the currents of pseudopodia.

The difference between latent and oscillating life lies, in short, in the almost absolute or simply partial inhibition of the internal currents. Water, heat, and oxygen are required as in a physico-chemical phenomenon, and I have often suspended the currents in my protoplasm by means of desiccation or refrigeration for months together. There is then another argument against my theory which regarded movements as a result of the discharges of carbon dioxide—a theory which has certainly been for me a source of fertile suggestion, though I have now given it up.

The importance of a large quantity of water in internal currents is perfectly demonstrated. I have shown that dilution has a great influence on the rapidity of the granulations in my artificial protoplasm.

Now, the gray substance contains more water than the substance in the cerebellum, and this has more than the white substance of the brain and medulla (R. Dubois). The neuroplasm has doubtless its currents, and the variations exhibited in their rapidity, as well as the shocks of their molecules and the waves produced, perchance, by the passage of the current from a conductor with a big calibre to a thinner one, may result in certain nervous and continuous actions or sensations, external stimuli provoking the vibrations, as I have studied in mercury.* On the other hand, Dubois says that anæsthetics produce the expulsion of internal water, and I have observed that exhalations of ether have the property of energetically repelling any thin layers of water ("On a Property of Ether," *Memorias y Revista Sociedad Alzate*, 1895–'96, Nos. 5, 6, p. 33). This means that anæsthetics modify the rapidity of the currents or even succeed in completely preventing them.

The action of alcohol on my artificial product is curious, there being a remarkable excitation of the movements followed by their absolute paralysis.

In the sea-urchin egg says Dubois, segmentation can be prevented by hindering hydration by the addition of of salt at 2 per cent to the sea water. When segmentation has already begun, it stops in a strongly salted medium, but it pursues its course directly after some normal water is poured on it; and, what appears more notable, it then continues with increased rapidity. I have observed analogous phenomena in artificial protoplasm.

In a word, the protoplasmic currents have a constructive or formative action comparable to that wrought by rivers on the earth's surface.

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* *Natural Science*, December, 1898.

Contractile vacuoles can be explained by an augmentation of tension promoted by some endosmotic currents. The former may be imitated by alternatively stretching and relaxing a plate of gluten.

Life ought not to be likened to a continuous chemical reaction, the mechanism of which remains involved in darkness and unexplained. Life is now to be defined as the result of the physico-chemical action of protoplasmic currents, the cause of such currents being diffusion, heat, and some other secondary factors. Death consists in an absolute suspension of the internal currents in general; latent life is characterised by the establishment of the said currents under the influence of oxygen, heat, and water, in a germ or organism having the structure and chemical elements necessary, and supplied with every nutriment required. Oscillating life is nothing more than an alternate contribution and reassertion of the constructive internal currents (sleep), depending upon the variations of the external temperature. Every physico-chemical or mechanical action capable of affecting the rapidity, direction, and other characters of internal currents must have more or less influence on the phenomena hitherto considered as vital.

There is a new series of proofs; the experiments of the writer on the movements and evolution of alkaline oleates in the Pfeffer's solution. (See "Memorias de la Sociedad Alzate," 1900).

Colouring of Water by Micro-Organisms.

BY JAMES BURTON.

It is well known, not alone to microscopists, that large or small bodies of water are sometimes coloured by the presence of various organisms, either animals or plants, often of microscopic size. Every roadside pond is liable to become of a thick soupy appearance and green colour from the multiplication in it of the very common *Euglena*, or some other of the unicellular algæ, such as *Protococcus*. Frequently portions in similar localities appear pink or red, owing to the existence in them of immense numbers of some of the Daphniæ or water-fleas. In the two cases now to be described, the colour, though extremely marked and characteristic, was the result of the presence of less common organisms.

Early in October the ornamental water in the Botanical Gardens, Regent's Park, appeared of an almost uniform pale green. On close examination this was seen to be due to some minute bodies diffused through the water; they were not merely floating on the surface, but seemed about equally distributed at all visible depths. Every twig and thread of water-weed, etc., at the margin was covered with what looked to the unassisted eye like tiny green balls, while in the quiet corners and backwaters towards which the breeze was blowing, the same bodies were collected in such quantities as to resemble thick light-green paint. Under the microscope it was found that the tiny balls were of irregular outline, and consisted of small algæ in colonies of various sizes, formed of more or less spherical groups. These were made up of very numerous individuals, oval or pear-shaped, so minute that the green colour noticeable in the aggregations was not distinguishable in them. The groups were hollow and surrounded by a thin layer of jelly or mucilage. In many cases there seemed to be spines radiating from the individuals, but these have no real existence, and the appearance is probably due to the mucilage composed of the swollen outer cell-walls of the separate members not having yet entirely coalesced.

The colonies, I think, have no motion within themselves, but, being of nearly the same specific gravity as the water, are very readily moved about by any slight current, such as would be set up by wind, or by the sun shineing on the surface and causing a difference of temperature between different layers. Owing to the disengagement of gas under the influence of light, there is a tendency in the organisms to rise to the surface, while the gelatinous envelopes make them cling to one another and to any object with which they come in contact. Thus are larger and more noticeable masses formed, which, however, have very little cohesion, and disperse again readily. My somewhat doubtful identification of *Coelosphaerium kutzingianum* is approved by an authority who kindly took the trouble to examine specimens. A figure is given in Dr. Cooke's "Introduction to Freshwater Algae," and the size of the individual cells is stated to be 2 to 5 microns, and that of the families 60 microns. The alga is probably not rare; but as it was not recognized by two or three microscopists to whom it was shown, it is most likely seldom noticed, and certainly does not commonly occur in such numbers as to give any tint to the water it inhabits.

Attempts to mount these algæ in several preparations of glycerine were not successful, the groups breaking up. Chlor-zinc-iodine (Schulze's solution) gave better results. So did some other fluid media; but the distinctive characteristics are hardly likely to be enduring.

A somewhat more remarkable instance, both as to the color and its cause, came under notice in January, 1898, in a farm pond at Hampstead. When first seen, the water appeared of a rosy-pink tint, owing to a growth which had formed on dead leaves and debris of various kinds. About a week later, however, the pond presented a striking aspect. When some distance from it, the water seemed to be of a beautiful intense red-purple, so exactly resembling what might be reflected from the sky in a fine winter sunset that I involuntarily turned round as I approached, almost expecting to see the sun setting behind. On closer examination it was seen that every leaf and twig at the bottom was of this brilliant tint. Some floating patches of Confervæ looked like masses of vivid purple, without a particle of their normal green being visible. The organisms producing this effect were spread in a thin layer over everything, and also formed delicate filaments lightly attached, which, however, were dissipated by the slightest movement. On agitating the Confervæ or leaves, the color-containing matter was at once diffused through the water.

Under the microscope it was found to consist of exceedingly minute bodies, so small that a very definite outline could scarcely be made out with a power of 500 diameters. These were surrounded by a thin layer of mucilage, and mostly aggregated into hollow spheres; many were solitary, but some were gathered in masses. The filaments it was almost impossible to examine in their original form, but they were composed of the same minute bodies disposed more or less in line. A friend kindly brought the matter under the notice of a professor of botany, who at once identified the organism as a bacterium now named *Beggiatoa roseo-persicina*. He referred me to the paper by Dr. Lankester, published in "The Quarterly Journal of Microscopical Science" for 1873, N. S., vol. xiii. Dr. Lankester there describes, under the name of *Bacterium rubescens*, an organism he discovered in some jars containing putrescent remains of animals and plants which had been undisturbed for a short time. The point to which he pays most attention is the remarkable color of the "plastids," which he considered characteristic of the species. There is little doubt that it is the same species mentioned by Dr. Cooke in his "British Freshwater Algæ" as *Pleurococcus rosco-persicinus* Rabh., with the remark that it is "certainly not a good pleurococcus." He gives the size of the individual cells ·0015 to ·004 m. It is not mentioned in the same author's "Introduction to Freshwater Algæ." I do not see the reason for classing this bacterium with *Beggiatoa*, as to me it seems it would be more correctly considered as a *Micrococcus*.

Apart from the color, the most interesting fact about these lower forms of life is that, while ordinarly present to a small extent, occasionally, owing to favorable conditions of environment and food supply, they multiply so enormously as to have the effect described. Thus giving a visible example of what must occur invisibly during epidemics of diseases, such as influenza and plague, which, according to modern science, are caused by microorganisms distantly related to them.—*Science-Gossip.*

The Blood in Health and Disease.

For anything approaching accurate microscopic blood work it is necessary to have at least a 1-12 inch oil immersion objective with a one inch eye-piece. This combination will magnify about 1000 diameters. Such a power will enable one to study the various kinds of corpuscles and their pathological variations; and will reveal as well the malaria plasmodium and all the smaller bacteria.

Blood specimens are sometimes examined fresh, that is shortly after the blood is drawn and before it has dried; and, secondly, specimens are prepared by drying, fixing, and staining—a process which serves to bring out the various elements of the corpuscles in different colors.

To prepare fresh blood specimens for examination, we should clean a slide and cover slip with alcohol or ether upon a clean towel, and carefully rub dry and polish them in the towel, not touching their surfaces but catching them by the edges to handle them and laying them aside upon clean white paper.

Prick the finger or ear to draw blood, after first cleaning the part with alcohol on the towel and rubbing dry. Wipe away the first drop that appears and then just touch the cover glass to the apex of the next drop so as to obtain

stain. The latter stain is so difficult to prepare it is best to buy it already prepared and tested.

For ordinary work in examining blood the following stains and methods of work are perhaps as convenient, simple and efficient as any other. Prepare the solutions as follows:

A. A saturated alcoholic solution of methylene blue, and keep as a stock solution.

B. Stock solution A 1 cc. aqua distillat 9 cc. This is an ordinary counter stain for blood and pus, but the next solution meets almost every need, so that B may be dispensed with.

C. Loeffler's M. B. solution: Stock solution A. 30 cc. 1-10,000 solution of KOH 100 cc. This is the stain to use for the diptheria bacillus, but it is as good as any other preparation to use for a counter stain. The weak aqueous solutions of M.B. deteriorate and need to be frequently renewed.

D. Eosin 0.5 grm. 75 per cent alcohol 100 cc.

E. Ehrlich's tri-acid stain, which is purchased already prepared.

To stain with Eosin and methylene blue:

1. Clean and polish two cover glasses and a slide with alcohol and a towel.

2. Puncture to draw blood. Touch one cover slip lightly to the drop, and place it upon the other cover slip so that the blood spreads between their surfaces. After blood has spread, catch these glasses by their edges and draw them quickly and smoothly apart so that each glass shall be covered with a blood film or "smear."

3. Dry these specimens in the air or by holding them near a flame where the hand can endure the heat. If the specimen dries too slowly, crenated corpuscles are apt to result.

4. Fix the film either by heat or in some solution.

To fix by heat the simplest method is to draw the specimen three times through an alcohol flame—holding the cover slip in a spring forceps. A more accurate method is to place it on a metal plate at 110° F. for 20 minutes. To fix by alcohol, place the slip in alcohol for from a half hour to twenty-four hours. The following mixture will also give excellent results:

Forty-per-cent solution of formaldehyde m. v. Aquæ destillat m xlv. alcohol q. s. Immerse the specimen in this solution for five minutes. Then stain.

A. Cover the slip with the eosin solution D (it is only necessary to flood the film side of the specimen). Let it remain from one-half to one minute and wash by running water over the specimen until the water comes away clear.

B. Flood slip with methylene blue solution C. Let it remain about two minutes and wash as before.

6. Dry either as the specimen was first dried, or in clean filter paper.

7. Mount in a half drop of Canada balsam upon a slide, placing the film side down in the balsam. Examine with the oil immersion lens, dropping a half drop of cedar oil on the upper surface of the specimen.

To use Ehrlich's stain we proceed exactly as above excepting we should write:

5. Flood the slip with Ehrlich's tri-acid stain. Let it remain from three to five minutes and wash. The washing and drying should be done quickly, especially if ordinary hydrant water is used.

The first method of staining is equivalent to the use of Plehn's solution which is a mixture of eosin and methylene blue. Staining by eosin and methylene blue causes the red corpuscles to appear red, the cytoplasm of some leucocytes very faintly blue, while all of the neuclei are stained blue. The granules of the eosinophiles stain decidedly red, and the neuclei are a pale blue.

Extracts from Postal Microscopical Society's Note-books.

Edited for Science Gossip.

Development of Gnat.—My object in these slides is to illustrate the transformation of an insect. I am not able to send a slide of the eggs of the gnat, but in "Science for All" Mr. Hammond says that they are laid in small boat-shaped masses which float on the surface of the water. The eggs themselves are of an oval form with a kind of knot at one end, and are arranged side by side and closely packed together. In Duncan's "Transformation of Insects" it is thus written: "The male gnats have pretty hairy antennæ, like little feathers, and the females have antennæ which are almost plain. It is therefore not difficult to distinguish one from the other, and it is rather important, for the females are the blood-suckers. When about to lay their eggs they seek the water, and with the assistance of their long hind legs collect and agglutinate them together and place the little boat-shaped mass upon the surface of the water, and then leave it to its fate." The larvæ are soon hatched, and grow with great rapidity. They are almost always seen with their heads downwards and their tails towards the surface of the water. After the larvæ have grown to a certain size they undergo a change of skin and become nymphs or pupæ, and it may be noticed that when the nymphs come up to the surface of the water they do not present their tails like the larvæ, so as to obtain air, but allow their backs to touch the surface, just where there are two respiratory tubes. When the perfect insect is about to emerge from the nymph stage it floats on the surface of the water, perfectly at rest, and the skin of the back, which is exposed to the air, dries and splits open. Then the perfectly-formed insect begins to come out: first it protrudes its head, then a portion of its body, and after a short time one leg after the other is disengaged from the nymph skin; after a little while it tries its wings and flies away. It will be noticed that the female gnat has no halteres.—*T. G. Jefferys.*

The best account of the gnat known to me is that given by Proffessor Miall in his "Natural History of Aquatic Insects," from which the following are excerpts: "Small stagnant pools and ditches are the favorite haunts of the larvæ and pupæ of the gnat. A ditch in a wood choked with fallen leaves is one of the best hunting-grounds, and in the summer months they may be found by the thousand in such places. The larva, when at rest, floats at the surface of the water. Its head, which is provided with vibratile organs suitable for sweeping minute particles into the mouth, is directed downwards, and, when examined by a lens in a good light, appears to be bordered below by a gleaming band. There are no thoracic limbs; the hind limbs, which are long and hooked in the chironomous larvæ, and reduced to a hook-bearing sucker in *Simulium*, now disappear altogether; a new and peculiar organ is developed from the eighth segment of the abdomen. This is a cylindrical respiratory syphon, traversed by two large air-holes, which are continued along the entire length of the body to supply every part with air. The larva ordinarily rests in such a position that the tip of the respiratory syphon is flush with the surface of the water, and thus suspended it feeds incessantly, breathing uninterruptedly at the same time." Professor Miall's explanation as to how it is possible for a larva heavier than water to remain floating at the surface without effort, as the larva of the gnat appears to do, is too long to give here. It deals with the surface film. "After three or four months the larvæ are ready for pupation. By this time the organs of the future fly are almost completely formed, and the pupa assumes a strange shape, very unlike that of the larva. At the head end is a great rounded mass which encloses the wings and legs of the fly, besides the mouth parts and other organs of the head. Each appendage has its own sheath, part of the proper pupal skin, and the appendages are cemented together by some substance which is dissolved or softened by alcohol. At the tail end is a pair of flaps which form an efficient swimming fan. The body of the pupa, like that of the larva, is abundantly supplied with air-tubes, and a communication with the outer air is still maintained, though in an entirely different way. The air-tubes no longer open towards the head. Just behind the heart of the future fly is a pair of trumpets, so placed that in a position of rest the margins of the trumpets come flush with the surface of the water. Floating in this position the pupa remains so long as it is undisturbed; but if attacked by any of the predatory animals which abound in the fresh water it is able to descend by the powerful swimming movements of its tail." Then follows an explanation, too long to quote, as to why the respiratory organs are changed from the tail end in the larva to the head end in the pupa. "But a time comes when the fly has to escape from the pupa-case. The skin splits along the back of the thorax, and here the fly emerges, extricating its legs, wings, head, and abdomen from their closely-fitting envelope." "The mouth of the female gnat is provided with a case of instruments for piercing the skin and drawing blood. The foremost of these is a tube split along its hinder side, which lies in front of the rest, and is used in suction. This, though long and slender, is stouter than the delicate parts behind it, and it serves to stiffen and protect them; then come fine, long, and slender blades of great delicacy. Two pairs correspond to the mandibles and maxillæ of other insects, though here they are so simplified and attenuated that it is not easy to make out the correspondence. The maxillæ are furnished near their tips with a row of extremely minute saw-teeth. There is also a fifth unpaired implement, which is an extraordinary development of a part of the insects's mouth, which is usually quite inconspicuous. Besides these piercing implements, the gnat is provided with a soft, flexible sheath which represents the labium. This takes the shape of a tube split along its foreside, which surrounds and protects the delicate parts within. The extremity is divided into lwo lobes."—*J. J. Wilkinson.*

Quotations from Proffessor Miall need no further explanation. The gnat (*Culex pipiens*) would make an excellent study for microscopical beginners, perhaps even more so than the common cockroach. We may call attention in addition to the beautiful antennæ of the male gnat, and to the scales upon the wings and body, which latter can be readily removed by means of a camel-hair brush, and so transferred to a slide. The larva in particular makes a most interesting microscopical object, owing to its transparency, which enables the tracheal tubes, the digestive tube, and contractile vessel that performs the duty of the heart to be readily made out. The gnat *C. pipiens* must not be confused with the allied genus *Chironomus*, or Midges.—*Science-Gossip.*

Notes on Microscopy.

M. I. CROSS.

Drawing with the Camera Lucida.—Photo-micrography has largly displaced the use of the camera lucida for reproducing structure as seen through the microscope, but in numerous cases photo-micrography does not do justice nor reveal details in such a manner as to permit of a proper judgment being formed of the appearance of the subject; photo-micrography will only show one plane sharply at a time, and all sense of solidity, depth, etc., is lacking. When a drawing of an object is made, the perspective can be reproduced and a far better and truer idea given of the object generally, subject of course to the delineation being accurate, than photography will permit.

Drawing with a camera lucida is an acquirement which calls for a considerable amount of practice, and is not successfully undertaken without a large amount of skill in the use of the pencil. This condition being fulfilled, very beautiful work can be and frequently is done. Probably the most generally useful and popular of all the camera lucidas is that known as Beale's neutral tint, in which a piece of tinted glass is set at an angle of 45 degrees to the eye-lens of the microscope, the upper surface reflecting the image to the eye. I have a decided preference for this pattern, although it suffers from the disadvantage of necessitating the microscope being set horizontally, and the image is reversed at the top and bottom, while the sides remain constant. Still its simplicity recommends it, and very little acquaintance with it enables one to utilize all its capacity.

For many purposes a camera lucida that works with the microscope vertically, horizontally, or placed at any angle is desirable, and for such the Abbe Camera is generally considered the best. The object is drawn as seen in the microscope, and, when working, the mirror reflects the image of the pencil point and paper on which the pencil is tracing, into the apparent field of view. I have recently been working with Ashe's Camera Lucida with the modifications described by Mr. Scourfield in the *Journal* of the Quekett Microscopical Club for 1900, and believe that for many purposes this will be found the most practical and convenient pattern of camera. It combines the ease of working of the Beale's neutral tint without the transposition of the object and has not the disadvantage of bulk possessed by the Abbe Camera. It can be used at any angle to which the body of the microscope may be inclined, from 45 degrees to the horizontal, quite comfortably, and by turning it round sideways on the eyepiece, it can be used at any angle from the vertical to 45 degrees. The image from the eyepiece is received upon the mirror which consists of a silvered disc of microscope cover-glass mounted on a brass plate, which can be revolved by the pin. The image is then reflected to the neutral tint glass which revolves on the pin and the same effect is produced as in the Beale's pattern, excepting that there is no reversal of the sides.

I can strongly recommend the trial of this little device. Much of the failure in drawing with camera lucidas is due to the attempt to use eyepieces of too high power. It will be invariably found that an eyepiece magnifying six diameters or even less is the most satisfactory, and this equally applies to Ashe's Camera Lucida.

COLORR-PHOTO-MICROGRAPHY.—It has often been deplored that although very exquisite reproductions of delicate structure can be made by photo-micrography, no satisfactory means have been available for reproducing exquisite colour tints, which make the vision of numerous objects through the microscope so entrancing. Attempts have been made, and not without a marked degree of success, by means of the tricolour process of Ives and others, but it called for a high degree of technical skill, and a vast amount of patience, experiment, and time.

The Sanger Shepherd process of natural colour photography overcomes the majority of the difficulties which prevented workers from embarking on attempts in this direction. It is true that the results cannot be printed on paper, but must be viewed as transparencies; but they admit of ready exhibition through a projection lantern, and for direct examination can be held or supported towards a suitable white backing.

The great advantage of it is that no alteration has to be made to the ordinary camera. The recommended adaptation to the camera consists of a repeating back to carry three plates. Immediately in front of these plateholders are fixed colour screens, which are guaranteed to be of exactly the correct absorption, and are adjusted by an improved form of Sir W. De W. Abney's colour sensitometer.

Three negatives of the same subject are taken, each with its appropriate colour filter. One print is taken from each of these negatives, and then stained by means of special solutions which are supplied. The three prints are then bound together in superposition to form a finished picture, and the result, if care has been exercised, is very fine.

Those who are in the habit of lecturing on microscopical subjects, or who have hesitated to do so because they cannot sufficiently reproduce the natural appearance of objects, should make a trial of this process, and a very little practice with it will cause them to be gratified with the results.

To View Multiplied Images–in the facets of the cornea of a beetle's eye is quite simple. An easy method of doing it is to place on the mirror a small cross cut out of black or brown paper, about $\frac{3}{8}''$ long; illuminate in the usual way and focus the facets with $\frac{1}{2}''$ objective. Then gently rack the objective upwards from the object, at the same time moving the paper cross on the mirror, very slightly, with a needle point, and the cross will appear in each of the facets. The needle itself will probably indicate the direction in which the cross should be moved in order to view it in the centre of the facets. The real secret lies not in focussing the facets themselves sharply, but in racking the body upwards until the cross comes into view, and focussing that sharply.

Notes on Microscopy.

F. SHILLINGTON SCALES, F. R. M. S.

Royal Microscopical Society.—June 19th, William Carruthers, Esq., F. R. S., President, in the chair. At the special general meeting several alterations in the by-laws were put and agreed to unanimously. At the ordinary meeting Mr. T. H. Powell exhibited *Coscinodiscus asteromphalus* under a new 1-40 inch apochromatic oil-immersion objective; Mr. J. W. Gordon read a paper entitled "An Examination of the Abbé Diffraction Theory of the Microscope," in which he stated that the above long-accepted explanation of the phenomena of high-power microscopic observation had been adopted on insufficient proof, and would not bear the test of critical examination. The Abbé theory claimed that pictures formed by the microscope of very minute objects were due to diffraction images originated by the object, and that when the oblique rays of light by which these diffraction images existed were excluded no image of the object was possible. This theory had been experimentally illustrated by Professor Abbé by means of a grating on the stage of the microscope and a series of diaphragms behind the microscope object-glass with slits to partially exclude oblique rays. Mr. Gordon showed that, although under such favorable circumstances diffraction effects were produced by fine objects on the stage of the microscope, these effects did not appreciably influence the form of the image. He also showed that the experimental results produced by the above-mentioned diaphragms, which were adduced to prove the theory, were due to a diffraction effect produced by the diaphragms themselves, and not by the grating on the stage of the microscope, the same results being obtained with an aerial image of a grating projected upon the stage by a lens in place of the actual grating. He maintained that in the microscope, as in the telescope, it was necessary to eliminate diffraction effects as far as possible by making lenses of larger aperture, and not, as in Abbé's theory, to include as many disffraction phenomena as possible. Diagrams in illustration of the paper were thrown upon the screen, and the various experiments referred to were exhibited under a number of microscopes. Professor S. Thompson regretted that he had not heard the first part of the paper, and had not had time to read the advance copy of the paper which had been sent to him. He entirely agreed with Mr. Gordon in rejecting the explanation of the Abbe theory given by Nageli and Schwendener, but found himself at variance with Mr. Gordon on almost every other point, and proceeded to discuss several conclusions arrived at in the paper. Mr. Julius Rheinberg having criticised the paper adversely at considerable length, Mr. Conrad Beck said he did not think it possible for anyone who had followed the experiments described by the author to dispute his contention that the effects observed were produced by the diaphragm behind the objective. The proof that the effects were entirely due to this was shown by the fact that if any of the conditions were altered the experiments did not succeed, and there was no reason why they should not succeed if the Abbé theory were correct. Mr. Gordon contended that he was entitled to the support of Professor Thompson, notwithstanding the impression his speech had probably left on the minds of those present. Professor Thompson agreed with him in throwing over Nageli and Schwendener's explanations, but considered it wrong to throw over the Abbe theory; whereas the quotation at the beginning of the paper made it clear that Professor Abbé had himself thrown it over. In doing so, however, he had promised to elaborate it further. As he had not yet done this, one was obliged to pick it up where it might be possible to find it, and so he was obliged to go to Nageli and Schwendener's book.

THE BRYOLOGIST.

A quarterly journal devoted to the study of North American Mosses Subscription price fifty cents. Sample copy 15 cents. Mrs. A. M, Smith, 78 Orange Street, Brooklyn, New York.

NEW PUBLICATIONS.

MICROSCOPICAL ANALYSIS OF DRUG POWDERS.—An atlas for all apothecaries, druggists and students of pharmacy. By Dr. Ludwig Koch, Professor of Botany, at Heidelberg University. Appearing in parts—3d Fasiculus. Leipzig and Berlin. The Borntraeger Bros., 1901.

The third fasciculus of this suberb work, which completes the first volume, is just at hand and is in every respect well worthy of those that have already appeared and of which we have heretofore spoken at length. The present number finishes up the Barks and takes up and finishes the Elements of Wood Fibres, Wood Parenchymata, etc. Four plates (from X to XIV) and two tables.

We desire to impress upon students of pharmaceutical microscopy the importance of this work. Nowhere else, in all the literature of the profession, can the microscopical structure of this most important part of the stock of every druggist, be found so plainly and excellently depicted. In the text all the methods are of procedure are fully explained, so that with the book in hand the druggist is always in position to thoroughly test the purity of his powdered drug.

The price of the volume just completed is 12 marks, and in accordance with the announcement made originally, that of the second volume will be 15 marks. It is obtainable only on subscription, which may be made at a bookstore, or sent directly to the publishers at Berlin.

SANITARY INVESTIGATIONS OF THE ILLINOIS RIVER.—The Illinois State Board of Health has issued a report on the Sanitary Investigations of the Illinois river and its tributaries and the sewage coming from Chicago and the Des Plaine and Illinois river prior to and after the opening of the Chicago Drainage Canal. ("Identification of Bacteria Found in the Waters of the Illinois River and its Principal Tributaries."—The Illinois State Board of Health, Springfield, pp. 219, one map, 1901.) Dr. Zeit and Dr. Futterer conclude from the results of their bacteriological studies, that the number of bacteria increase with high water and decrease with low water. Seriously polluted water becomes pure again after flowing for some distance. Pathogenic as well as sewage bacteria decrease as the organic matter decreases, but water bacteria increase. The presence of saprophytic bacteria will hasten the removal of organic matter and the death of pathogenic bacteria. The authors did not succeed in finding any typhoid fever bacilli. Experiments indicate that they die in a few days in Lake Michigan tap water. The addition of boullion keeps them alive a somewhat longer time, but when saprophytes are added at the same time, exhaustion of food supply again causes early death. The Bacillus coli-communis may be found in water without sewage pollution and if found may not be virulent. Bacterial purification begins at Joliet. Sewage bacteria decrease markedly at Morris and still more at Ottawa where the bacteriological flora of Illinois river and Fox river do not reveal great differences. Among the pathogenic bacteria found were Anthrax and Tetanus. The Coli-communis was found 55 times; B. lactis ærogones, 16 times; B. enteritidis, 10 times ; Proteus vulgaris, 40 times ; P. mirabilis, 3 times; B. pyocaneus, 2 times; B. tetani. 3 times; Staphylococcus pyogenes aureus, 3 times; B. anthracis, 2 times. L. H. Pammell.

◆

Outfit for Sale.—Objectives : 1-5″ R. & J. Beck, adjustable, ½″ and 1½ Elliot Bros. adjustable; One bull's-eye condenser, large, never used ; One silver side reflector ; One stage forceps ; 2 life boxes, one large and one small ; 20 slides of arranged diatoms, test plates, costing me some $30 alone. My eyesight having suffered, (else I should not sell), I will take $50.00 for the whole.

W. C. Pollner, Cleveland, Ohio.

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Diatomaceae of Gage's Pond, Topeka, and of Silver Lake.

GEO. H. CURTIS.

Although the Diatomaceæ of the eastern United States have been pretty thoroughly investigated by several competent observers, I believe that little is known as to what forms exist in the West. With the exception of Thomas and Chase's catalogue of the Diatomaceæ of Lake Michigan, which embraces 34 genera and 214 species, and my own catalogue of the Cincinnati forms, 42 genera and 972 species, there are no investigations of western or central-western forms known to me.

In company with Mr. Frank Patrick, I paid a visit to Gage's pond, in the western suburbs of Topeka, about the middle of October. It was dug by Mr. Gage a number of years ago as a fish-pond and stoned up. I did not think of estimating its dimensions while there, but is perhaps 150 feet long by 50 feet wide, and two or three feet deep. Our object in visiting it was to ascertain if it contained diatomaceous material; and, while there, I made a gathering which, when cleaned up a few days afterward, yielded some very interesting slides, and some *Naviculæ* not previously met with elsewhere.

The most abundant form in the gathering was *Epithemia gibba*, both the long and the short varieties. The most common *Navicula* was *radiosa*. *Cymbella stomatophora* of several sizes was also common; and *Amphipleura pellucida*, a rare form, more than usually abundant. My gathering was made on the east side, about midway; and it was rather curious that there was no *Amphipleura* in Mr. Patrick's gathering, made only a short distance away at the south end, or from the under sides of the leaves of the water-lilies, of which many were growing in the pond. *Synedra ulna*, var. *longissima*, was abundant, especially in Mr. Patrick's gathering. *Gomphonema* was rather rare. There was a considerable number of large, somewhat curved, sponge spicules. *Navicula cuspidata* was a prominent form—both the long and the short varieties. *Cymbella*, usually one of the most abundant forms in any gathering East, was very scarce at Gage's pond, as well as *Gomphonema*.

The most noticeable thing about the gathering was the remarkable predominance of the rare form, *Epithemia gibba*, of which there were, in a field taken at random, under a quarter-inch objective, no less than seventy-eight individuals, as compared to nine *Cymbella*, four *Navicula*, thirteen *Syndra*, and four *Denticula*—almost three times as many as all the other forms together.

As some may not have had experience with the microscope, I would say that the field of view mentioned above was round, and one-fiftieth of an inch in diameter. This will convey some idea of the exceedingly minute size of these diatoms: that 108 of them, as mentioned above, could, without any crowding whatever, be placed in a circle of that size.

To give an idea of the rarity of *Epithemia gibba* at other places, I may say that, in the forty-four slides from which my catalogue of the Cincinnati Diatomaceæ was drawn up, representing about thirty different gatherings, this diatom is found in only two of them. In a very remarkable gathering I made from the Fox river, at Elgin, Ill., a half-inch mount of which contained ninety-four recognized species, only two *Epithemia gibba* were observed, and in one from a pond in Oakwood park, Elgin, none; nor were there any in fine gatherings made at places so widely scattered and generally representative of the West and South as Lake Geneva, Wis., Hailey's Springs, Idaho, or Calera, Ala. There were none in a gathering I made from the Chicago water-supply, though it is catalogued in Thomas and Chase's Diatomaceæ of Lake Michigan, from which the city water-supply is derived. Two fine gatherings made in northeastern Ohio, near Ashtabula, contained no *Epithemia gibba*. A gathering made early in October from the fountain basin on Twelfth street, two or three blocks southwest of the capitol, in Topeka, contained hardly anything else but this *Epithemia*; so that its abundance here seems to be a remarkable peculiarity of this locality, depending, perhaps, on some constituent of the water-supply unusually favorable to it. If so, it must, I imagine, be derived from the Republican branch of the river, as a gathering I made from the Blue at Beatrice, Neb., last year, contained none of this diatom.

In connection with *Amphipleura pellucida*, mentioned above, it is not only very rare, but is placed at the end of Moller's test plate as the most difficult test object known to microscopists, and is stated in scientific text-books to be the smallest regularly organized thing known. Of course, the delicate markings referred to below are not visible at 775 diameters, and the lines across the middle are merely a very coarse imitation of them, to show their direction, etc.

Mr. Patrick informed me that he very carefully examined the alga the *Amphipleura* was growing on and found it to be *Cladaphora fracta* Kg., which I believe only grew over a small space on the east and north walls, a fact very interesting, as showing that it is probably parasitic on this alga, and only found in connection with it, something not before observed, so far as known to me. This would account for its not being found under the lily-pads, or at the south end, where this alga did not grow. The rarity of this diatom may be due to the fact that this alga does not grow everywhere.

I once measured *Amphipleura pellucida* by a Rogers stage micrometer, and found it not quite one two-hundredths of an inch in length. The smallest grains of ordinary sand which can be picked up with a pair of watchmaker's tweezers and arranged as close together as possible under a magnifying glass go only sixty-four to an inch, so that the length of this diatom is only a little over one-quarter of the diameter of one of the finest grains of sand; yet in this short length it is marked with 340 of the finest and most regular lines ever seen ruled across it, and each line apparently composed of rows of beads. I counted these lines on an excellent photograph of it, by Doctor Detmers. A list of the genera and species found at Gage's pond is as follows:

Achnanthes minutissima. Amphipleura pellucida. Amphora libyca; ovalis. Cocconema australicum; cistula; lanceolatum; mexicanum; a large unknown, perhaps new. Cymatopleura elliptica; solea (both long and short). Cymbella gastroides; stomatophora; turgidula. Denticula elegans; tenuis; thermalis. Diatoma tenue. Encyonema lunula; turgidum. Epithemia gibba; gibba, var. ventricosum; sorex, short form. Eunotia gracilis; lunaris; lunula. Fragellaria intermedia; mutabilis.

Gomphonema abbreviatum; affine; affinis; angustatum; angustatum, var. intermedia; angustatum, var. producta, Grun; commutatum; constrictum; gracile, forma parva; lagenula Kg.; mexicanum Grun.; obtusatum; olivaceum; parvulum; parvulum, var. subcapitata. Melosira lyrata, var.(?). Meridion circulare.

Navicula acrospheria, var.(?); arenaria Donk.; bacilliformis; biceps Ehr.; brebissoni; cuspidata; decurrens (Pinn.); divergens, forma minor; elliptica, var. oblongella; flanatica; gibba (Pinn.); hemiptera; interrupta; lanceolata; lanceolata, var. much smaller; mesolepta; nodosa, var.; No. 15; No. 44; No. 45; No. 55, Schmidt's Atlas, pl. 7, with some reserve; oculata; oblonga; peregrina; producta; pseudobacillum; radians; radiosa; radiosa, var. acuta; retusa; rhyncocephala; rostellata; small, elliptical, coarsely marked; schumanniana; stauroneiformis; stauroptera; stomatophora Grun.; subinflata; tabellaria Grun.; trinodis; ventricosa, forma minuta; viridis (Pinn.); viridula Kg., forma minor.

Nitzschia frustulum; sigma; small, unknown, coarse markings. Pleurosigma spencerii. Stauroneis anceps; phœnicenteron; unknown, small. Surirella apiculata; molleriana; ovata; ovata, var.; panduriformis; suevica. Synedra crotonensis; danica; familiaris; pulchella; superba; ulna, var. longissima; ulna, var. vitrea.—Total genera, 21; species, 108.

Many more might undoubtedly be discovered by devoting time to the more thorough examination of the slides, as I never sit down to them without finding something new. As sixty species is a fair average for the best gatherings, it will be seen that this at Gage's pond was unusually good. A gathering made at Silver Lake, twelve miles west of Topeka, yielded much the same forms, except that in a half-inch mount of it only two *Epithemia gibba* were observed, and with the following additions:

Achnanthes hudsonis; exilis; lanceolatum. Cocconema cistula (a new variety). Cyclotella comta; meneghiniana. Cymatopleura apiculata. Encyonema triangulum. Fragellaria turgens. Gomphonema affine, forma major; gracile. Melosira crenulata; varians. Navicula ambigua; ampliata; confervacea, var. peregrina, Grun.; lanceolatum; sphærophorum. Nitzschia dissipata; hungarica; paradoxa; sigmoidea; tryblionella, forma minor; tryblionella forma densus striatæ; tryblionella, var. victoriae. Pleurosigma eximium; hippocampus(?); delicatulum. Surirella intermedia. One additional genus, *Cyclotella*, and twenty-nine species.

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Disinfection Against Msoquitoes.

M. J. ROSENAU, P. A. S.

Until lately, mosquitoes and flies were looked upon merely as annoyances, but since it has been proved that they are able to transmit the infection of pestilential diseases, we must now regard them as dangerous vermin. When the matter is generally understood, it will be a greater reproach to the housewife to have mosquitoes and flies in the home than bed bugs, and it is the duty of sanitarians to spread an abhorence for these most common and most dangerous of domestic pests. The mosquito is known to transmit the infection of malaria and filariasis. That the mosquito transmits yellow fever must now be accepted as an established fact. The next problem is the destruction of the infected mosquitoes.

It is a well-known fact that formaldehyd gas readily enters into combination with the protoplasm of the lower forms of vegetable life, which makes it a very efficient germicide. It is, however, not toxic to the higher forms of animal life. It is very irritating in its effect upon the mucous membranes of rats, mice, guinea pigs, rabbits, and mammalian animals generally, but not necessarily fatal, even after prolonged exposures. Many insects, such as roaches and the like, may be exposed to strong concentrations of the gas a long time without effect.

Formaldehyd gas kills mosquitoes whenever the gas comes in direct contact with them in sufficient concentration and for a sufficient length of time. When exposed *directly* to the gas produced by any of the methods commonly used for disinfecting purposes, the mosquitoes die within a few minutes. If the insects are confined in a bell jar and some formalin is dropped inside, they soon show signs of agitation and shortly drop down, dead. They may, however, live over night in a very feeble atmosphere of the gas.

The conditions necessary to obtain this direct contact, however, can not always be obtained in actual practice. Rooms are frequently not tight enough to obtain the concentration of the gas required. The mosquitoes can not be held in direct contact with the gas, for their sense of self-preservation helps them to escape. The period of irritation, lasting several minutes even in the bell jar, enables the insects to hide in available places, such as the folds of garments, hangings, or fabrics, or in the cracks and crevices where the gas only reaches in a diluted form. If the room is not thoroughly sealed, some of the mosquitoes will surely get away, for their instinct in finding tiny avenues of escape is remarkable. The escape of one infected mosquito might be the spark that would rekindle an epidemic.

In general, it may be stated that to succeed in killing mosquitoes in a closed space with formaldehyd gas, the following definite requirements are essential. A large volume of the gas must be liberated quickly, so that it may diffuse to all portions of the room in sufficient concentration. The room must not have cracks and chinks where the insects will breathe the fresh air entering, especially if these openings are to windward. The room must not have heavy drapery, clothing, bedding, or other fabrics, so disposed that the insects may hide in the folds, away from the full effects of the gas.

In order to compare the merits of formaldehyd with sulphur dioxid gas in disinfection against mosquitoes, experiments were made by burning sulphur and with the liquid sulphur dioxid gas.

The power of sulphur dioxid to destroy all forms of animal life is well known. On account of its destructive action upon fabrics and metals, this agent is of little practical use in the disinfection of dwelling houses, cabins of ships, and similar places. This destructive action is due to the moisture which combines with the sulphur dioxid to form sulphurous acid, which is the real disinfecting agent. Dry sulphur dioxid has practically no effect upon bacteria. Our work has shown that very small atmospheres of the dry gas will quickly destroy mosquitoes, and we therefore believe that the destruction of these insects may be accomplished in dwelling houses with little danger of injuring fabrics or tarnishing metals. Sulphur dioxid is so far superior to formaldehyd as an insecticide that even the risk should not outweigh the certainty of its action. The gas may now be obtained in its liquefied form, either in tin cans, in syphons, or in iron cylinders, affording very convenient methods of quickly introducing a given amount of the dry gas into an inclosure.

A series of experiments was also made to determine whether chemically dry sulphur dioxid has insecticidal properties. It is well known that the anhydrous gas has practically no effect upon bacteria. As the dry gas is not destructive to fabrics and metals, it is of considerable practical importance to know whether it will kill mosquitoes.

To this end the liquid sulphur dioxid was liberated in a bell jar, but first passed through 2 drying columns containing pumice stone saturated with sulphuric acid. The moisture contained in the air of the bell jar was eliminated in 2 ways, (1) by drawing air through the drying columns into the bell jar, or (2) by introducing calcium chlorid into the bell jar. It was found, in all these tests, that the mosquitoes were killed, practically instantly, by the dry gas.

Contrary to formaldehyd, which requires an exposure and strength of gas sufficient to destroy spores in order to entirely rid a room of mosquitoes, sulphur dioxid will kill these insects even when the quantity of the disinfectant and the time of exposure are reduced so that non-spore-bearing bacteria are unharmed. Sulphur dioxid was for a long time used as a disinfecting agent against yellow fever, and experience found it to be trustworthy. But later it was disparaged because laboratory tests showed that it lacked the power of killing spores and has little penetrating power through fabrics. But now that we know it is the mosquito which carries the infection, the usefulness of this agent is revived.

Formaldehyd gas is a feeble insecticide. Mosquitoes may live in a very weak atmosphere of the gas over-night. It will kill them, however, if it is brought in direct contact in the strength and time prescribed for bacterial disinfection. For this purpose any of the accepted methods for evolving the gas is applicable, but the methods which liberate a large volume in a short time are more certain than the slower ones.

Direct contact between the insects and the gas is much more difficult to obtain in ordinary room disinfection against mosquitoes than against germs, because the sense of self-protection helps the former to escape from the effects of the irritating gas. They hide in the folds of towels, bedding, clothing, hangings, fabrics, and out-of-the-way places where the formaldehyd gas does not penetrate in sufficient strength to kill them. The gas is polymerized and deposited as paraform in the meshes of fabrics, which prevents its penetration, and large quantities are lost by being absorbed by the organic matter of fabrics, especially woolens. In our tests, whenever the insects were given favorable hiding places, such as in crumbled paper or in toweling, they quickly took advantage of the best place for themselves and thus escaped destruction.

There is a striking analogy between the strength of the gas and the time of exposure necessary to penetrate the fabrics in order to kill mosquitoes, and the strength and time necessary to penetrate in order to kill the spores of bacteria.

Mosquitoes have a lively instinct in finding cracks or chinks where fresh air may be entering the room, or where the gas is so diluted that they escape destruction. They are able to escape through incredibly small openings. Some of the smaller varieties, such as the *stegomyia fasciata* can get through a wire screen having 12 meshes to the inch. Therefore, formaldehyd gas can not be trusted to kill all the mosquitoes in a room which can not be tightly sealed.

It is concluded, that to succeed in killing all the mosquitoes in a closed space with formaldehyd gas, the following definite requirements are essential: A very large volume of the gas must be liberated quickly, so that it may diffuse to all portions of the space in sufficient concentration. The room must have all the cracks and chinks where the insects may breathe the fresh air carefully sealed by pasting strips of paper over them. The room must not contain heavy folds of drapery, clothing, bedding, or fabrics in heaps, or so disposed that the insects may hide away from the full effects of the gas.

Sulphur dioxid is unexcelled as an insecticide. Very dilute atmospheres of the gas will quickly kill mosquitoes. It is quite as efficacious for this purpose when dry as when moist, whereas the dry gas has practically no power against bacteria. Contrary to formaldehyd it has surprising powers of penetrating through clothing and fabrics, killing the mosquitoes, even when hidden under 4 layers of toweling, in one hour's time—and with very dilute proportions.

This substance, which has so long been disparaged as a disinfectant because it fails to kill spores, must now be considered as holding the first rank in disinfection against yellow fever, malaria, filariasis, and other insect-borne diseases. A pamphlet giving in detail all the experiments by which the above conclusions were reached can be had from the Marine Hospital Bureau.

Structure of Diatoms.

FRANK J. KEELEY.

In studying the structure of diatom valves some years ago, the method employed, mounting broken valves at right angles to the cover glass, proved efficient for most of the coarsely marked forms, but failed with certain species of *Aulacodiscus*.

Such forms as *A. sollittianus*, *A. margarataceous*, etc., yielded satisfactory sectional views and proved not to differ materially in structure from *Coscinodiscus* but another group, including *A. oreganus*, *A. rogersii*, *A. janischii*, etc., proved too opaque for the elucidation of their structure by this method. Further examination of fragments in which the plates were separated indicated, however, that the typical "honeycomb" cellular structure was likewise present in these species, but masked by the unusual character of the external plate, which differs from that of other diatoms in having the finer secondary structure between, rather than over, the large cells of the middle plate.

Recently, with the view of further determining the relations of this structure to that of other species, a special mount was prepared, including *A. oreganus*, *A. rogersii*, with typical species of *Concinodiscus*, *Triceratium*, *Actinocyclus*, *Actinoptychus*, etc. The various forms were arranged in a line on a square cover-glass, supported on the slide by bands of cement at two opposite edges, thus permitting the fluids of varying refractive indices to be passed under the cover and withdrawn by the use of blotting paper in the manner familiarly known as "irrigation."

The fluids employed consisted of absolute alcohol, cedar oil, oil of cassia and mixtures of same, giving refractive indices from about 1.37 to over 1.60. Starting with the lowest refractive index, the appearance of each diatom was carefully noted under low, medium and high aperture objectives, and it was found that all the species represented, with the exception of the two *Aulacodiscii*, became fainter as the refractive index was increased up to about 1.435, when they were entirely invisible, except where in contact with the cover-glass. As the index of the medium surrounding them was increased above this point they became more distinct, the coarser forms being almost opaque in oil of cassia. This is exactly what should be expected, either on theoretical grounds or based on previously published experiments, but in the case of the two species of *Aulacodiscus* mentioned, the distinctness of visibility under a low power seemed to increase from the start, and in the medium where other forms disappeared they were even more strongly outlined than in alcohol, while under an oil immersion-objective no difference could be noted in the sharpness and contrast with which the secondary structure was shown in any of the various fluids, although portions of the internal plates, which extended beyond the external plate in broken forms, were extinguished with the rest of the diatoms on the slide, showing that the anomalous behavior of these species was confined to the external plate, containing the secondary structure. Neither heating to redness on plantinum foil nor boiling in strong acids has the least effect on the appearance of the secondary structure, nor is there anything to indicate that its appearance is due to difference in composition rather than of structure. With the facts at present available it would be useless to hazard a conjecture as to the true nature of this structure, but it may be safely affirmed that in the external plate of this group of species of *Aulacodiscus* we have a structure essentially different from that found among other diatoms.

Aulacodiscus Oreganus is one of the few diatoms that show bright colors with central transmitted light. The two valves of this species included on slide under observation, when examined with a three-fourths-inch objective of .25 N. A., were bronze-yellow when dry, yellowish gray in alcohol, blueish gray in medium of 1.41 R. I., iridescent blue in medium of 1.44 R. I., deep greenish blue in cedar oil, dark green and pink in oil of cassia.

The question of colors shown by diatoms in direct light has recently been treated in the Journal of the Quecket Club, with special reference to *Actinocyclus ralfsii*, by E. M. Nelson, who has shown that the color cannot be due to diffraction. The two valves of *A. ralfsii* which were included in the previously described slide showed only pale brown and grayish tints in media of R. I. below 150, and extinguished with the other forms in one of R. I. about 1.43. In cedar oil one valve showed a blue color and in oil of cassia both became brilliant with green, blue, purple and yellow. Under wide aperture objectives the color is not visible when diatom is sharply in focus, but it appears as soon as thrown slightly out of focus. This color appears to be due to dispersion, and its nature and cause might possibly be further elucidated by studying the effect produced by different media such as were employed in this case.—*Proc. Phila. Acad. Natural. Sciences.*

Diatoms, The Food of Fish in Kansas.

GEO. H, CURTIS.

Mr. S. G. Mead, of McPherson, gave me a small fish about two inches long, which he caught at Belvidere, Kiowa county, Kansas, last fall. It was apparently a young perch, to judge from its shape and the dark bands along its sides. Having a curiosity to know what its food had consisted of, I undertook a microscopical examination of the contents of the digestive tract; but the difficulty of arriving at satisfactory results was much increased by the carbolic acid and oil the fish had been preserved in, which interfered very much with the proper action of chemicals, especially acids, and did not seem to yield well to either soap, benzine, or alcohol.

The investigation was, therefore, not altogether so satisfactory as I could wish; but was sufficiently so to establish the main points, and to prove that their food consists very largely of diatoms, mostly *Naviculæ*, of the *radiosa* type; of which I was able to make a very satisfactory examination, to be referred to again further on. There were also many starch grains, shown by the polariscope to be those of the potato, and about as many, perhaps, which were smaller, and possibly derived from bits of bread. There were also a number of green bodies of roundish contour, which were without much doubt desmids. They had been too long subjected to the action of the gastric secretions for the species to be exactly made out, but they were probably *Cosmariums* of some sort; and their numbers were apparently too small for them to have formed a very important part of the fish's diet. About a dozen grains of corn-smut were met with, all in one place.

There was a very considerable quantity of white sand in the stomach and intestines, hardly any field of view in the microscope one-fiftieth of an inch in diameter being without a number of grains of it. They were generally of about the same size as ordinary river sand, and polarized equally well. In one field of the size mentioned above there were thirteen grains of it, in another nine, and in a third five, of three taken at random. It may be possible, though hardly probable, that this sand was swallowed accidentally. It is, however, far more likely that it was swallowed designedly, to aid the process of digestion, as is the case with birds; and the size of these sand grains would, considering the difference in size of the two creatures, apparently bear a just proportion to the little stones swallowed for this purpose by fowls.

They may also have been swallowed to act by their weight as ballast to counteract the natural buoyancy of the body, like the stones of considerable size usually found in the stomachs of alligators, and which are supposed to have been swallowed to assist them in remaining at the bottom.

The fact that there were no grains of black sand among it, which does not polarize, would rather seem to lend support to the digestive theory; inasmuch as white sand, being composed of quartz, or almost pure silica, and hard enough to scratch glass, would naturally be selected by them to assist in the grinding or trituration of their food, rather than the much softer black sand.

There was observed at one place an agglomeration of small, round grains, quite smooth outside, like very small fish eggs, which they perhaps were, or spores of some small toadstool or other fungus. They were transparent, and not much over one-quarter the size of the grains of sand mentioned above.

A great quantity of some dark-colored substance, finely comminuted and apparently of animal origin, was found, perhaps the remains of worms or meat of some kind; but, although most carefully sought for, there were no feet, wings, scales of lepidoptera, parts of insects, crustaceans, or muscular fibers of any sort among it, such as would have been likely to have survived the digestive process and given a clew to its character.

As we may see from the smallness and degree of convexity of their eyes that fish must be capable of seeing things infinitely smaller than would be visible to the human eye, this matter was perhaps composed of minute particles of both animal and vegetable origin which the fish met with and swallowed as it swam about, and which were perhaps too small to preserve any definite recognizable character, especially after passing through the stomach.

Their principal food, though, to judge from the great numbers of frustules of different kinds found in the stomach and intestines, were diatoms, the outer shells of which being composed of almost pure silica, are well-nigh indestructible by the digestive process, fire, or the strongest acids.

After preparing the diatoms for examination under the microscope, it was seen that the greater part of these small organisms in view were *Navicula* of small size, of the type known as *radiosa*, *arenaria*, etc., of two or three sizes, or of the *lanceolata* form, with divergent striæ, such as are figured in Schmidt's Atlas of the Diatomaceæ (plate 47) or varieties of that type. Some were much larger and some smaller, but mostly of the same general type.

Gomphonema was, as usual in Kansas gatherings, very rare, though four or five species were met with. *Cymbella*, also one of the commonest forms anywhere East, was equally scarce; and I had about concluded that none except small forms were present, when I unexpectedly came across an *Amphiprora* of the largest size, and of a decidedly rare variety, not found in the forty-four Cincinnati slides. The individuals of this family are among the largest diatoms; and they were remarkably abundant, as if there was a savor or a large body of nourishment in them which had especially appealed to the fish's taste.

A noticeable thing was not only the abundance of this large and rare *Amphiprora* not found at Gage's pond or Silver Lake, but the remarkably large numer of fine *Pleurosigma*, mostly *spencerii* or varieties, every field containing at least one and often several.

An unusually large form of *Amphora lineata*, not found at Gage's pond, Silver Lake, or in the forty-four slides of Cincinnati diatoms, was quite abundant. Only one *Navicula* of the *rhomboides* type was seen, and that was a variety, the *Colletonema vulgare* of Thwaites. *Stauroneis phœnicenteron*, one of the few distinctively fresh water forms said to be found everywhere, was not met with.

Epithemia gibba, so remarkably abundant at Topeka, was present, but rather uncommon. Of the three or four species of *Nitzschia*, only one seemed to be of a common variety, and one of them, *Nitzschia sigma*, is catalogued by different authorities as a marine form. A most remarkable thing was that not a single *Surirella* of any kind was seen in the three slides mounted. As they are one of the most abundant forms everywhere, and there being plenty near at Medora, we must either conclude that there were none where the fish lived, or that they possessed some poisonous or other undesirable qualities which caused him to reject them.

One of the most remarkable things found was *Mastagloia*. The genus is almost exclusively marine or brackish, and only one of the two species areever found in fresh water, and they are excessively rare. This one, *M. lacustris*, was not found at Cincinnati; though an allied species, *M. lanceolata*, was recognized there with some slight reserve. It is also catalogued by Thomas and Chase, but none of either was found at Gage's pond or Silver Lake. Another seems to be what Grunow calls *Nitzschia apiculata*, though the blank line down the center and the absence of alea seem to identify it with *Synedra*.

To give an idea of the relative proportions of the genera present in a field of view one-fiftieth of an inch in diameter, selected merely because it had an *Amphiprora* in it, so as to include that, there were the one *Amphiprora*, one *Amphora*, one *Cymbella*, two *Nitzschia*, three *Pleurosigma*, and thirty-four *Navicula*.

The genera and species, so far as observed, were as follows:

Amphiprora conspicua (?), (perhaps columetica?); paludosa W. S., said to be British. Amphora cymbifera Greg,; lineata; No. 18, Schmidt's Atlas, pl. 39. Cocconeis pediculus. Cocconema australicum A. S.; cistula; helveticum; hungaricum; lanceolatun; mexicanum. Cyclotella rotula; a small unknown.

Cymbella affinis; gastroides; helvetica; kamchatica Grun.; minuscula Grun.; No. 40 of Sch. 9, not named; stomatophora; tumidula; turgidula; two small unknown. Denticula splendens. Encyonema lunula. Epithemia gibba; gibba, var. ventricosum; gibberula; like musclus, but ends not so sharp; uncertain; zebra. Gomphonema abbreviatum; angustatum, var. intermedia: capitatum; clavatum; commutatum, var. subramosum; intricatum, var. pumila; olivaceum; olivaceum, var. vulgaris; ventricosum. Homœocladia sigmoidea. Mastagloa smithii Thw., var. lacustris, Grun.

Navicula amphiceros (?); bacillum; borealis (var. small, with nine coarse striæ); brebissonii; cymbula Donk; elliptica; elliptica, var. oblongella; gracilis (Kg.) Grun.; gregaria Donk; interrupta (Pinn.) S. W.; lanceolata (Kg.), var.; leptogongyla; longa; macra; mutica, var. goeppertiana; large, coarsely marked, lanceolate, unknown; No. 11 of Schmidt's 47, not named; No. 13 of same, not named; No. 15 of same, not named; No. 22 of Schmidt's 44, but rather coarser; No. 32 of Schmidt's 44, with some reserve; obtusata; pumila Grun.; radiosa Kg.; radiosa, var. acuta; rhomboides, var. (Colletonema vulgare Thw.); rupestris (Pinn.) Grun.; smithii(?); subcapitata, var. stauroneiformis; subinflata; stauroptera; stauroptera parva Grun.; tabellaria; tenella; unknown, perphaps naveana(?).

Nitzschia amphioxys, var. vivax; angustata; frustulum; heufleriana; hungaricum; sigma; stagnarum Rabh.; triblionella. Pleurosigma gracilentum Rabh.; spencerii; sciotense; kutzinghii. Synedra acus; crotonensis; danica; familiaris; an end of, perhaps. Chaseii(?); pulchella, forma major; ulna.—Total genera, 16; species, 100.

Notes on Microscopy.

F. SHILLINGTON SCALES, F. R. M. S.

PREPARING SMALL MARINE INVERTEBRATES.—The following method of preparing small marine invertebrates for microscopic study may be of service to some of our readers. It was originally contributed to the "Journal of Applied Microscopy" by Mr. H. P. Johnson, the aim being to retain as fully as possible the natural form, transparency, and coloring, and at the same time to have the specimen instantly accessible for re-examination. The specimen is placed on a slide in a few drops of pure sea water, and slightly compressed with a cover-glass provided with wax feet. The compression can be quite accurately regulated by pressing down the wax feet at the corners of the cover-glass, or prying up the cover-glass, a little at one or more corners with the point of a scalpel. If the specimen is a worm, it will contract at first; but afterwards will usually become fairly extended. After two or three hours the worm, although still living, becomes almost perfectly quiescent. A few drops of a 4 per cent solution of formaldehyde are then run under the cover-glass, its flow being hastened by draining away with bibulous paper an equal quantity of water at the opposite side. The worm should die in a fairly extended condition. A sufficient quantity of formaldehyde should be run under to displace all the sea water. After an hour or so the gradual replacement of the formaldehyde with glycerine may begin. Mr. Johnson has always used undiluted glycerine, but suggests that a mixture of equal parts of glycerine and water might be safer for very delicate objects. The glycerine is applied in the same way as the formaldehyde, but more gradually—only two or three drops at a time. After the specimen has become completely surrounded and permeated with pure glycerine, the mount is sealed with Venice turpentine in the manner explained in Lee's "Vade Mecum," fifth edition, p. 291.

The preparations will keep almost indefinitely without sealing, but with the obvious disadvantages that the glycerine is likely to flow over the slide in moist weather, and a mist gathers on the cover-glass. The preparation should be flat at all times. This method has been found to meet all the requirements of the case for small Annelids and Echinoderms, and would probably be equally successful for a wide range of minute animal forms, excepting always those with impermeable chitinous integuments, like the Arthropods. *Syllidae* and other small Polychetes up to a length of four or five centimetres have been successfully treated, and preparations made three years ago are as beautiful and instructive as at first.

DEMONSTRATIONS OF MICROSCOPIC MANIPULATIONS.—Mr. C. Baker informs us that he has decided to set aside four afternoons in each month from October to the end of June for the demonstration of microscopic manipulation. These demonstrations will be given on the first and third Fridays and second and fourth Tuesdays, from 3 to 6 P.M. Each demonstration will consist of an exhibition of about eight microscopes, together with illustrative diagrams; and the instruments will be set up, ready for inspection, at the times stated, so that those who have but a short time at their disposal will not be delayed by preliminary preparations. Three of the demonstrations will deal with illumination, one with the comparison and testing of objectives, and two with the various methods of recording observations. Further particulars can be obtained from Mr. C. Baker, 244 High Holborn, W.C., and we need only to add that the demonstrations will be free to all, and no obligation to puchase is incurred by those availing themselves of the offer. It cannot be too strongly insisted upon that the modern microscope is essentially an instrument of precision, and requires education in its use if full advantage is to be taken of its capabilities. We hope therefore, that these demonstrations may prove successful.

EDWARD WARD.—A well-known figure in Manchester scientific society was recently removed by the death of Mr. Edward Ward at the age of 57 years. He was born at Coventry, where in his early life he worked as a ribbon weaver. Having a natural taste for scientific investigation, he soon became possessed of a microscope and later of a primitive camera. His tastes quickly brought him into association with others, which led to his leaving the loom for the vocation of commercial traveller. Notwithstanding the difficulties incident upon the constant change of locality when thus occupied, he contrived while on his journeys to study, dissect, stain and mount thousands of objects. In 1887 he issued his first list of purely scientific lantern slides, which gave an impetus to science work in the district. He was one of the founders of the Manchester Microscopical Society, and for several years one of its presidents, and a lecturer in its Extension Section. It will, however, be on account of his photographic work that he will be best remembered. It is said that he took no less than ten thousand photographs of Geological Sections during the construction of the Manchester Ship Canal, and also of its chief engineering features. To attain such a remarkable pictorial history of that gigantic undertaking, Mr. Ward used at least once a month to walk along the whole course of the works between Manchester and the Mersey above Liverpool during the period of construction, which lasted beyond five years.

C. BAKER'S SLIDE-LENDING SYSTEM.--The system of slide lending—initiated, we believe, by Mr. C. Baker, and since adopted by other firms, such as Messrs. Watson & Sons, of London, and Mr. Abraham Flatters, of Manchester—was a departure that had much to recommend it. Mr. Baker's system, in brief, is that for a subscription of $5, the subscriber becomes the recipient of twelve deliveries of twenty slides each, post free both ways. These slides can be arranged for delivery at stated times—say, fortnightly during the winter months, or the time of receipt and return can be left to the varying convenience of the subscriber. The choice of slides is most comprehensive; in the list before us we note twenty-five sets of ditoms alone, and four sets of bacteria. The mere examination of slides, however, whether arranged for a definite purpose or not, falls far short in interest and in educational value of the same slides accompanied by the necessary descriptions and explanations. Recognizing this, Mr. Baker has now arranged that full descriptions shall accompany the slides lent, and has given us the opportunity of perusing several of these sets of detailed notes.

The scheme is excellently carried out by competent writers, though the work entailed thereby must have been considerable, as the notes run in each case into many pages. For instance, a set of twenty slides dealing with bacteria is accompanied by a succinct and carefully-written introduction to their study, after which follow detailed descriptions of the respective slides, so that the examination of each becomes a little lesson in itself, the methods of examination and, in certain cases, of preparation not being omitted. Another set of twenty slides deals with Mollusca, and in the accompanying descriptions we recognize a well-known writer on marine zoology. The following extracts will show the nature of these notes.

Dealing with the palates of Mollusca, the writer says: "With but two or three exceptions the mouths of Gastropods and Cephalopods are furnished with a tooth-bearing, ribbon-shaped band, variously known as the radula, odontophore, lingual ribbon, palate, or tongue; an organ of use in scraping, cutting, boring, or masticating, according to the habit of the particular animal. It is often of very considerable length, and consists of an anterior portion working over a cartilaginous swelling, the regular cartilage, upon the floor of the mouth, while the longer hinder portion is lodged and formed within a large radular sac, which in reality is a deep cylindrical depression of the floor of the mouth. When the radular is very long, as in the limpet, the radular sac lies free, folded several times upon itself, within the body-cavity immediately between the viscera and muscular foot disc. Throughout life new teeth are continuously added by secreting cells situated at the blind end of the radular sac; the singly-refractile core of each tooth being secreted by certain cells upon the floor of the sac, while the enamel-like, doubly-refractile outer layer is laid on by those of the dorsal wall.

As mentioned, that part of the radular which is in use plays over a pulley-like cartilaginous cushion, and by the alternate contraction of two sets of muscles, protractors and retractors, attached at one end to the base of the cushion and at the other to the radula, the latter is dragged backwards and forwards over the cartilaginous pad, as an ostler polishes the inside of fixed rings by pulling a cloth to and fro within. Listen to the limpets as they rasp slowly over the rocks, and you will understand clearly how effective is this radula in scraping off minute vegetation that coats the rock. The sound given out is too definite to be mistaken. The scraping action of the radula is also very easily studied in a fresh-water aquarium containing a few water-snails. As the teeth in front wear down, the ribbon is bodily moved forward sufficiently to permit new teeth to come into use." Then follows a detailed description of the teeth and of the classification.

From notes accompanying a miscellaneous set of slides we extract the following remarks on a slide showing the prismatic raphides in the cuticle of an onion (*Allium cepa*): "Lime enters largely into the composition of all organic bodies. In human bones, for example, the salts of lime constitute 65 per cent of the whole mass, or more than double the amount of animal matter. There are very few plants in which these limey crystals or raphides are not found. They vary considerably in size and shape, and it is by no means difficult to detect them by cutting thin sections of plants and examining them under the microscope. A glass slip, a cover-glass, and a little water are all the mounting materials necessary. They will not, of course, come out so clearly as in a slide made by a professional mounter; but it is always interesting to do something for oneself, and facts observed in this way are firmly impressed on the memory. The simplest form of raphides is to be found in the lilies, where these bodies occur in the form of bundles of needle-like rods occupying the centre of the cell. In the strip from the outside of a lily stem they are seen under an inch as an almost solid mass in the protoplasm of the cell; but the ¼-inch will resolve this mass into its constituent parts, when the needle-like bodies lying side by side can be made out distinctly. In the onion the raphides are prismatic in form, and may be seen scattered over the whole section; the walls of the cells in which they are enclosed can be clearly made out, and each cell contains a single crystal or raphis."

FORMALIN AS A PRESERVATIVE FOR PLANTS.—The use of formalin for the preservation of zoological specimens is now very general. Its application to the preservation of plants and flowers, however, is quite new. The most satisfactory results are obtained with a 5 per cent solution of formaldehyde, *i. e.* an eighth of the strength of the commercial formalin, which contains 40 per cent of formaldehyde. The flowers and portions of plants immersed in this and kept in the dark remained intact, whilst the tissues became more or less translucent, showing the structure. After seventeen months, yellow calceolaria flowers had lost but little of their color, whilst a tulip and hyacinth had lost about 30 per cent. A pansy exposed to diffused light in a 5 per cent solution was rapidly bleached, with the exception of the lower yellow petal. A white tulip became translucent, but retained its external form perfectly. The odor of mignonette was still perceptible after four months, nothwithstanding the penetrating odor of the formalin itself. Unfortunately the solution soon bleached blue colors. A blue hyacinth became opaque white in two days and translucent in six months. Green leaves became only slightly translucent, and were otherwise unchanged. In order to prevent the bleaching action of sunlight it was found essential to keep the specimens in as dark a place as possible. The preservative action of the formalin is due to its destroying all external micro-organisms, and preventing the inter action of the plant-cells by contracting their protoplasm.—*C. A. Mitchell, London, in Science-Gossip.*

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Ethmoid Diaphragms.

JOHN M. ORDWAY.

In some monocotyledonous plants there is a kind of tissue of which there is no description in any botanical work within my reach. This constitutes the cross partitions or diaphragms of the air passages extending the whole length of the petioles, leaves, or scapes. These diaphragms consist of one layer of flat, branching cells which join together so as to leave triangular, square, or oval apertures allowing easy communication between the different compartments of the same longitudinal series. If they have not been already named, they may very properly be called ETHMOID diaphragms,—from Ethmos, a colander.

Good examples are afforded by the tropical banana plant, Musa sapientum. Fig. 1 shows a cross section of the banana petiole one fourth smaller than the natural size. Fig. 2 represents a short piece of a section cut downwards from the line *a a* of Fig. 1. Fig. 3 gives a portion of an ethmoid diaphragm magnified about fifty times. Fig. 4 is a tranverse section, of one half the actual size of a sheath, taken a little below where it narrows and bends out to become the petiole proper. These sheaths extend down to the ground and together form the body of the plant. Air passages with ethmoids also make up

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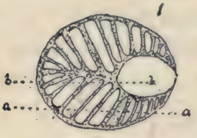

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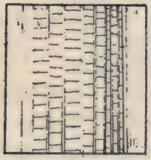

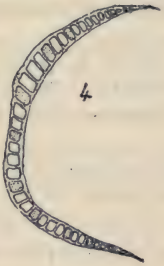
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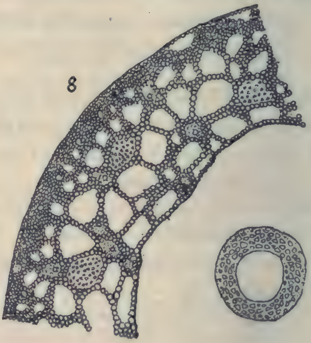

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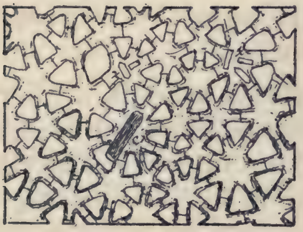
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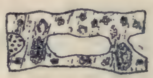
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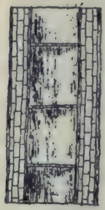
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a part of the large red bracts which protect the successive tiers of flowers and are thrown off, one by one, as the fruit develops. Fig. 5 shows a cross section of one them enlarged five times, the upper part being the outside.

The diaphragms, as shown in fig. 2, are hardly two millimetres apart. Therefore if we examine with the microscope several successive cross slices of a petiole, we shall be sure to find among them some that have one or more of the diaphragms in place. Or we may split off the side as in fig. 2, so as to expose the interior, and then cut just above and just below one of the plates. But it is better to remove the parts outside of *a a* and *b b* of fig. 1 and dissect out one of the diaphragms to examine by itself.

By suitable focussing it will be seen that the cells are somewhat convex. They not unfrequently contain distinct crystals of calcium oxalate as shown at *x*, fig. 3; and occasionally cells filled with raphides may be seen lying on the plates, as at *e*.

But where the Musa is not available, good specimens of the diaphragms may be readily obtained from the Pontederia cordata which grows in shallow waters everywhere. The petioles which spring from the rhizome consist mainly of sixty or more air-ways with cross plates less than two mm. apart. The flower-bearing stem of this plant has, besides about 150 small air-passages, a large central one in which the ethmoids are about five mm. from each other. After splitting the stem so as to expose this central cavity, one of the plates may be cut loose around the edges and be removed for examination. They are like fig. 3. In almost every transverse section of the stem, ethmoids may be seen in some of the smaller air-ways. And the same is true of the petioles.

Fig. 6 shows a cross section of a Pontederia stem of three halves the real size. Fig. 7 gives a short piece in longitudinal section on the same scale. Fig. 8 represents one-sixth of a cross section of ten times the natural size.

Another of the Pontederiaceæ, the very prolific Eichhornia crassipes (or speciosa), which has taken possession of our Southern bayous, abounds in air-passages with ethmoid plates. In one petiole, 380 air-ways were counted. The flower bearing stem, like that of the Pontederia has a large central passage in which the partitions are from 6 to 30 mm. apart. Around this central cavity the smaller air-ways are quite as numerous as in the Pontederia. There are two forms of petioles, the one short and inflated, the other tapering from the base upwards without special enlargement and reaching sometimes a length of 67 centimetres. Both may occasionally be found on the same plant. The rhizomes and runners by means of which this plant multiplies so rapidly, have a central solid part and, around this, numerous air-ways without diaphragms.

Fig. 9 shows an inflated petiole a fourth the actual size. Figs. 10, 11, 12, 13 give half the real size of successive sections of a tapering one that was 26 c. m. long, 10 being taken at the base and the others at the respective heights of 7.6, 15, and 23 c. m. The diaphragms in Eichhornia are like fig. 3, but the appertures are much smaller.

The Sagittaria variabilis of the Northern States and S. lancifolia of the South have diaphragms of a somewhat different type, the branches of the cells being much more numerous and many of the perforations having a long oval form. One of these plates is represented in fig. 14, enlarged 150 times. It will be observed that of the lines formed by the joining of the cell branches only two abut on each of the oval openings. Fig. 15 shows half the size of a petiole in cross section, taken half way up, in which were counted over 400 air-passages.

The flower-bearing stem of these plants has no large central hollow. In the sheathing petioles of the little Alisma plantago, which is of the same natural order as Sagittaria, the ethmoids are of an intermediate character, the cells having from six to twelve branches and there being only occasionally an oval aperture between the triangular ones. The flower-bearing stem is hollow and there are some ethmoids in the large cavity.

Of a still different type are the horizontal partitions in the leaves of Typha latifolia. Here they are made up of very slender, branching cells and the apertures are relatively large and very irregular in form. These apertures have more commonly four or even five cell joints abutting on them, instead of three. In most of the air-passages there may be found two or more very fine fibre bundles running down through the plates. Excepting these, the spaces between the plates are empty in the upper part of the leaves. But in the lower and sheathing part, the chambers are filled with slender cells branching in every direction, like those in the pith of Juncus effusus. The term "stellate" as applied to the Juncus cells,* and the figures shown in some of the books are far from giving a correct idea of the actual form. Sections made horizontally, vertically, or obliquely have about the same appearance. Hence the cell branches are quaquaversal instead of being in one plane, and they are quite irregular. This tissue resembles the texture of fine commercial sponge as seen under the microscope. It is spongioid.

The flower-bearing stem of Typha is solid. Fig. 16 gives a transverse section of a Typha leaf, of the real size.

Fig. 17 represents a portion of one of the diaphragms magnified 55 times. Fig. 18 shows a longitudinal of some upper air-passages of about twice the natural size, with fibre bundles running through the chambers. In planes further back other fibres would be seen. They appear as dots in fig. 16.

Diaphragms of a fourth type are found in the petioles, scapes, and spadix of Peltandra undulata. In this case the cell division lines run between the angles of the apertures instead of the sides; and so the cells are polygonal and not branching. As this plant is pervaded by a colorless jelly insoluble in water, slices are somewhat difficult to handle. But the slime may be removed by soaking three or four hours in weak ammonia water and then washing with clear water.

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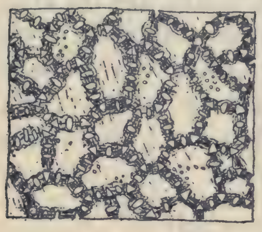
*In Engler's new "Das Pflanzenreich" these cells are called "Parenchymstrangen" and the diaphragms "Parenchymrippen," neither of which designations is particularly apt.

Fig. 19 represents a small portion of the Peltandra petiole in cross section. Fig. 20 is a view of one of the diaphragms enlarged 75 times. The cells show numerous grains of starch or chlorophyll. Richardia africana has the same structure as the Peltandra.

The sheathing petioles of Canna indica have about 25 air-passages arranged like those of the Musa. The diaphragms are from three to six millimetres apart and are thickish and somewhat obliquely placed. The intermediate chambers are filled with spongioid tissue, and this grows in close contact with the partitions so that it is very difficult to isolate them for examination. The diaphragms themselves are of the Peltandra type.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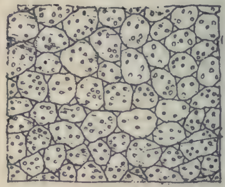
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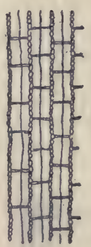
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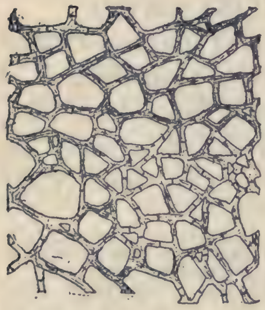
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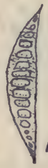
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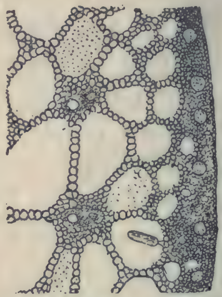
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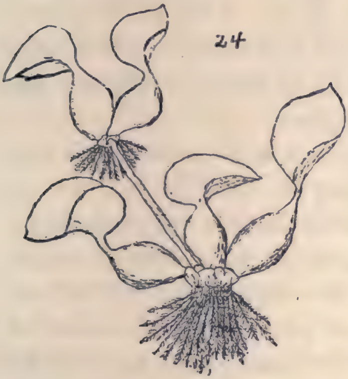
Some of the coarse grasses, like Zizania, have sheaths furnished like the Canna. Some have diaphragms without intermediate tissue.

The leaves of Acorus calamus and the petioles of Symplocarpus fetidus have very numerous air-passages with ethmoid diaphragms. Very good examples have been met within the leaves of some other plants, which however had no flowers or fruit to give a clue to their names. But one of these deserves special mention because the diaphragms are so different from those heretofore described. It is a rush-like plant, probably a Triglochin, with very narrow leaves about a foot long and oval in cross section. Here the cell joints are swelled so that, at first sight, they appear like interposed globular cells. The apertures are therefore triangles each of whose sides has a curved indentation.



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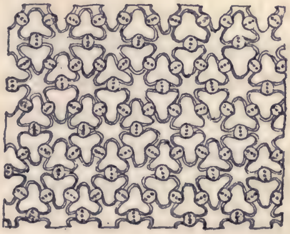

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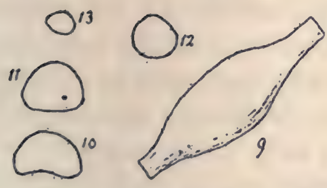

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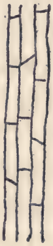

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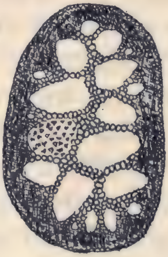

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Fig. 21 is a cross section, enlarged 18 times. Fig. 22 shows some of the air-passages and diaphragms on a scale of 7 to 1. Fig. 23 represents part of a partition magnified 175 times. But as this last was not drawn directly from the object, it is a little too regular.

It is evident that in the structure of organs with large air-chambers and ethmoid partitions, considerable firmness is secured with a minimum of solid material. At the same time the free circulation of air in all parts contributes to rapid growth. A banana petiole cut off at the base of the leaf and 42 c m. farther down was found to displace 239 c. c. of water and to weigh 57.5 grams. The net specific gravity was 1.085. Hence there were only 53 c. c. of vegetable matter and sap to 186 c. c. of air. The weight after drying was 5.04 grams. So we have about 1 measure of solid matter to 10 of water and 186 of air. This petiole sustained a leaf weighing 192 grams.

But for lightness the swelled petiole of the Eichornia must bear the palm. The one shown in fig. 9, of quarter size, measured 50 c.c. and weighed 4.4 grams. Air-dried, it weighed 0.334 grams. So 11-12 of the bulk was air, and 1-13 of the weight was solid matter.

Air-spaces with diaphragms seem to have some connection with the parallel veining of the leaves. In the leaves of Iris versicolor the partitions are not perforated. I have not yet found diaphragms in any dicotyledonous plant. There are four large air-ways in Nymphea odorata and many more in Nuphar advena, but here the remarkable, stout, many pointed, distinct cells may act like skewers to keep the parts in place and yet do not interfere with the flexibility. In Nelumbo lutea the same office appears to be performed by adherent clumps of calcium oxalate crystals which are purposely distributed along the inner walls of the four large air-passages.

H. S. Newcomb M. College, New Orleans, Oct. 31, 1901.

Catalogues of Microscopes, etc. can be had from ———
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The Fungi.

GEO. F MASSEY, F. L. S.

Next to the Phanerogams, or the flowering plants, the Fungi constitute the most extensive group of plants known. Just over 50,000 species are already described, and every year this number is being augmented. In Great Britain are 5,000 species of Fungi, which far exceeds in number that of all other groups of native plants —Phanerogams, Filices, Muscinae, Algae, Lichens—added together.

As in every division of the animal and vegetable kingdoms, the primary groups are indicated by one or two prominent morphological features, which are supposed to indicate a common origin, whereas other and unimportant or secondary characters presented by the group are often very varied. In the Agaricineae, a family including some thousands of species, the common bond of union is the presence of gills or thin plates bearing the spores or reproductive bodies on their sides. The members of this group are popularly known as toadstools, with the exception of the edible species of our pastures, which are dignified by the name of mushroom. The mushroom-eating public flatter themselves that the only fungus they eat is the true mushroom (*Agaricus campestris*). This, however, is far from being the case. *A. campestris* pure and simple is rarely if ever grown by cultivators, but in its place a variety of this species with a brownish more or less scaly cap, known scientifically as the variety *hortensis.* The horse mushroom (*A. arvensis*) is often sold in the London markets as the true mushroom. However, all these are edible, even if lacking in taste and aroma. In this instance "ignorance is bliss."

The uses of Fungi are various. As food products, owing to fear of poisoning, with the exception of the kinds mentioned above, the numerous edible varieties are mostly ignored, except by mycologists. The fungus popularly known as "bluewits" or "bluecaps," however, is often offered for sale. We have at least eighty different kinds of fungi perfectly safe and good to eat. Of these, forty kinds are common and widely distributed, the most abundant and one of the best being the "parasol mushroom" (*Lepiota procera*), one of the toadstool type, having a slender stem five to eight inches in length, and a flat brownish scaly cap six to nine inches across. The gills are persistently white.

The Morels, as they are called(*Morchella*) are amongst the best of edible fungi, and belong to a group of fungi that appear in the spring, when other kinds of edible fungi are absent. The species grow on the ground among grass, the stem is stout, and the cap or spore-bearing portion is globose or conical and marked on the outside with deep irregular depressions. In the Southern Hemisphere the counterparts of our Morels are parasites growing on trees.

There is only one genus (*Cyttaria*), and the species, so far as is known, only grow on the different species of evergreen beech. These southern Morels are not uncommon in Chili and in Tasmania, and were in both countries eaten by the aborigines, as they are at present by their successors. Several species of fungi are eaten by squirrels. Slugs and snails are also partial to some kinds, the poisonous species of *Russula* being especial favorites.

Poisonous fungi do undoubtedly exist, but among the kinds that are at all likely to be collected for food poisonous kinds are not so common as generally supposed. Probably 90 per cent of the deaths caused by poisonous fungi, are due to eating the "death-cup" (*Amanita phalleides*), or its near relation *A. mappa.* Why these fungi should be collected for food is not quite clear. They certainly do not in the least resemble any species usually considered as good for eating—least of all the common mushroom; perhaps it is on account of their neat appearance, and the absence of anything suspicious in the way of smell or taste that they tempt the uninitiated.

In the majority of fungi the spores are diffused by the wind, but in the most highly organized group (*Phalloideae*) the spores are distributed by insects, which, curiously enough, are attracted by color, scent, and nectar-like food, exactly as in the case of those flowering plants where cross-fertilization is effected by insects. The Phalloideae are most abundant in tropical regions. In Britain the group is represented by three species, two of which—the large stinkhorn (*Phallus impudicus*) and the smaller stinkhorn (*Mutinus caninus*)—are fairly common throughout the country, whereas the third, the latticed fungus (*Clathrus cancellatus*) is only met with on rare occasions in two or three southern counties. The smell in all species is very penetrating, and from the ordinary human standpoint intensely disgusting, although not objected to by flies and other insects, which pick up the scent and gravitate in great numbers towards its source, where they find a greenish dripping gluten, very sweet to the taste and containing the exceedingly minute spores imbedded in its substance. This mucus along with the contained spores is greedily eaten by the flies, and by this means the spores are distributed far and wide. In the most highly organized members of the Phalloideae, very varied and beautiful contrivances are present, serving as a platform for insects while partaking of their feast. These platforms are so arrange that the sweet mucus, trickling from the cap where it is produced, flows over their entire surface, thus affording standing room for more insects than if the mucus remained on the comparatively small cap.

In one species (*Dictyophora daemonum*) the fungus has a stout erect stalk four or five inches long, bearing at its tip the mucus and spore-producing cap. Springing from the stem just below the cap is a very beautiful network-structure fashioned like a lady's skirt or rather a crinoline which widens out downwards and reaches almost to the ground. Onto this crinoline the mucus spreads in every direction. In our latticed fungus the portion smeared with mucus is bright red, and resembles a hollow globe having a wall of network, the globe being about three inches in diameter. In other kinds variously branched coral-like appendages receive the mucus.

The subject of parasitic fungi is so extensive that an extended series of talks would be necessary to make clear even the broad outlines of the study, which embraces members belonging to every family of fungi, the individuals varying in size from the ephemeral microscopic mildews and rusts to the large woody structures, resembling inverted brackets, which grow upon and destroy forest trees. The following figures will give some idea of the enormous amount of injury done to the higher plants by parasitic fungi.

In Prussia, according to the Statistics Bureau, the loss on the crop of wheat, rye, and oats, caused by fungi during the year 1891, amounted to $100,000,000, almost a third of the total value of the crops. In Australia the loss on the wheat harvest of 1890-'91 due to rust wasestimated at $12,500,000. In the United States the vineyards have suffered terribly from the fungus pests. Up to the present time 30,000 acres of vines have been destroyed, causing a direct and indirect loss of 20,000,000 dollars.

These are not exceptional cases, but average illustrations of the disastrous effects produced by parasitic fungi on cultivated crops. Until quite recently these epidemics were accepted with calm resignation, being considered as deserved visitations for wrong-doing. At the present day most civilized countries are establishing experiment stations for the purpose of studying these pests and devising means for checking their devastations.—*Quekett Club.*

Extracts from Postal Microscopical Society's Note-books.

Edited for Science Gossip.

Eristalis Tenax, Longitudinal Section of Halter.—For convenience of examination the halter of the fly may be divided into three separate parts, viz. base, pedicle, and globe or head. On the exterior surface of the base there are three distinct areas or sets of sense organs which have severally an anterior, posterior, and lateral aspect. These have long been considered special sense organs. The lower area is somewhat rounded on the face, and covered with delicate elevations of the epidermis which take the form of circular papillae. They are divided into rows, and between each row there is a line of curved hairs. Lowne states that there are two distinct sets of these lower organs, and Theobold in his work on the "British Flies" has repeated this statement; but in no instance have I met with more than one, and it has invariably a lateral aspect. The two upper organs are placed on opposite sides of the halter, one anterior and the other posterior. They are much longer and larger than the lower one, but like it in having rows of ridges beset with papillae separated by fine hairs. Several sections show the lining epithelium remarkably well. In this place it is especially modified to form a sensory or nerve epithelium. The pointed ends of the cells are seen penetrating the papillae of the lateral organ. The halters receive their rich supply of nerves direct from the second thoracic ganglia. This pair of nerves is the largest in the thorax, and crosses to the opposite side immediately on entering the ganglia. The pedicle is a hollow tube connecting the base of the halter with the globe. On the external surface it is covered with hairs. The interior is divided by a septum which is continued the whole length. A large tracheal vessel passes through it to the globe, where it breaks up into many branches which ramify in the tissue.

Sarcophaga Carnaria, Longitudinal Section of Halter.—These sections show the vascular tissue in the so-called globe of the halter. In all the halteres I have examined the deep invagination seen in these sections of the globe is invariably present, and there is always a mass of connective tissue extending from the invaginated wall to the opposite wall of the globe. The purpose of the invagination is unknown to me, unless by some means it allows of a certain amount of expansion and contraction of the globe. The large glands most probably secrete a fluid necessary for organs at the base of the halter. The halteres of Diptera doubtless assist in their locomotion, but the evidence of their elaborate structure proves that they have another most important function. The positions of the papillæ are such as to present a front in every direction, and their structure is so delicate as to permit of vibration when sound-waves or other unusual movements of the air impinge upon them. Also the nerve epithelium bathed in fluid secreted in the globe, together with the very rich nerve supply, point to their being rudimentary nerve organs. Otoliths, so commonly found in the Crustacea and Mollusca, I have not met with here, but that does not prove their non-existence. The great number of papillæ (400 to 500) in each halter, and the small number of olfactory organs (two in each antenna) found in many flies which feed on the nectar of flowers, compared with *M. vomitoria* and *M. domestica*, whose halteres carry half the number of papillæ, and in whom the olfactory sense is highly developed, show that the former possess an acute sense to warn them of danger when their heads are buried in the blossoms of the plants they frequent, and that the latter have comparatively little use for such a sense.

Anterior Thoracic Spiracle of Blow-fly.—This spiracle is oval and narrowest above, and is situated between the pro- and meso-thorax. From the exterior free edge project hollow arborescent chitinous rods, which curveo utwards and interlock for about one-third of the length of the spiracle. These rods are hollow, even to the minutest twigs, which have a free opening at their points. Close behind is a transparent membrane, the true valve. It is united to the wall of the large tracheal vessel which extends across the thorax to the opposite spiracle. The free edge of the valve is closely set with a chitinous fringe. A special muscle arises from the integument at the lower end of the spiracle. By the contraction of this muscle the free edges of the valve would be caused to approach each other. From the integument another set of muscles arises, which are directed towards the valve, but whether they are connected with it I have not been able to determine. Antagonistic muscles are a necessary consequence for working the valve.

PROBOSCIS OF BUTTERFLY.—The tongue, or proboscis, is a cartilaginous substance, and owes its great flexibility to being formed in rings, which give it a finely-engraved appearance under the microscope. It is formed of two pieces that can be separated through its whole length, and each being grooved on the inner side they fit together perfectly air-tight; this is effected by an infinite number of fillets resembling the laminæ of a feather which interlace and adhere to each other. Between this groove and the outer skin is a space occupied by tracheæ or the breathing tubes. The proboscis is always carried coiled, but can be uncoiled in a moment. It is perfectly suited to the work of penetrating to the honey of flowers. We know how butterflies close their wings as they alight or a flower, when the insect makes a powerful expiratory effort by which the air is expelled from all tracheæ. At the moment of applying its proboscis to the food it makes an inspiratory effort by which the tube of the proboscis is dilated and the food ascends at the same moment to fill the vacuum produced, thus passing to the mouth and stomach, being further assisted thereto by the muscles of the proboscis.—*Mrs. W. Major.*

The function ascribed above to the tracheæ is a novel one, and it is difficult to understand how a vacuum can be produced in the œsophagus and its connections by driving the air out of them, even if it were possible. In insects the mouth can only be considered as connected with respiration in the most indirect manner, if at all; for although in certain acari the air-tubes open at the base of the mouth, there seems to be nothing analogous in insects. Respiration in insects is effected by means of two large canals, called "tracheæ," running along the sides of the body underneath the outer surface, which communicate with the air by short tubes called spiracles situate along the sides. I take it that these tubes can never be exhausted of the air they contain, seeing the walls are supported by spirally convoluted fibres, which impart great strength and prevent collapse; and that the air is changed within them, according to the necessity of the creature, by the closing or opening of the spiracles and the continuous rhythmic movement of the body. It may be well to say a few words with respect to the means by which in the Proboscidea the food is drawn up into the stomach. The Hymenoptera,the Lepidoptera, and Diptera are provided with a bladder-shaped distension of the œsophagus which would appear to be a modification of the crop, and is called a "sucking stomach." This is not a receptacle for food, but by its distension and the consequent rarefaction of the air contained therein it promotes suction of the same and facilitates the rising of fluids in the proboscis and the œsophagus, and it is by this means these insects rifle the flowers of their contents.—*E. Bostock.*

Notes on Microscopy.

F. SHILLINGTON SCALES, F. R. M. S.
AND H. A. HAIG.

COLORING OF WATER BY MICRO-ORGANISMS.—Much curiosity and speculation have been aroused in the neighborhood of Stoke Bridge, Ipswich, by the turbidity and deep chocolate color of the river Orwell, reaching for some little distance from each side of the bridge. This appearance has been ascribed by some to the scourings of the maltings, by others to spawn, also to the sun, or to the remains of star and jelly fish. This remarkable coloration of the river is in streaks of a greater or less width, and extends but a few inches beneath the surface, whilst on the decline of the sun the color wholly disappears. This phenomenon is caused by countless myriads of beautifully marked plants of a deep chocolate shade. This coloring matter can readily be discharged by chemical reagents and the green structure of the plant rendered apparent, or by the action of iodine the presence of starch can readily be determined. These plants bear a striking similarity in their movements and power of contractility to the fresh water Euglena, but in form they resemble a bicuspid tooth, with a deep cleft on each side of the axis. The two fangs might be taken to represent the head, and the crown the base; each plant being about the 1-3,000th of an inch in diameter. Some hundreds of these organisms may be seen gaily disporting themselves in a drop of water scarcely exceeding in size a pin's head, the whole being in a rapid state of motion. These brackish water organisms are delicate, breaking up a few hours after being removed from their habitat. The plants appear to come up with the tide, and are not due to the presence of sewage or other preventable matter.—*Alfred Martinelli, Ipswich.*

BRACT AND FRUIT-SCALE IN CONIFERAE.—The carpellaryscale in Pinus, or Larix, corresponds, as is well known, with a carpel in the Angiosperms, but differs in that it is not folded on itself, but is dorsi-ventrally flattened, and bears the ovules upon its upper surface. The bract is a scale-leaf, in the axil, and perhaps partly from the upper surface, of which the fruit-scale arises. The relative arrangement of the xylem and phloem in these two structures is peculiar, and has a distinct physiological bearing upon the question. In the fruit-scale we find that the phloem is uppermost, and adjacent to the under surface of the ovule, whilst the xylem is underneath. In the bract, on the other hand, the xylem is uppermost, lying adjacent to the under surface of the fruit-scale, the phloem being underneath. In this structure, then, the constituents of the bundle have the same relative position as in an ordinary bifacial leaf, whereas in the fruit-scale they have received a "twist," whereby phloem is brought uppermost. That the phloem should lie next the ovules is of importance, for the elements of this tissue merge gradually into those of the nucellus and seed-coat, and there is thus every facility for rapid diffusion of food material during the process of reproduction. Various views are held concerning the manner in which the altered relative position of xylem and phloem is brought about, but these need not be here discussed.

THE STRUCTURE OF THE NUCLEOLUS.—The "definitive" nucleus of *Caltha palustris* offers many interesting points for observation. In the first place, its large size, relatively to the dimensions of the embryo-sac, renders great aid to investigation, as also does the comparative ease with which sections may be made of the sac in the ovules. A longitudinal section of an ovule of *Caltha* at a certain stage prior to fertilization will, if the section be successful and carefully stained with hæmatoxylin, safranin, and toluidin blue, show us all the structures contained in the embryo-sac. These are (*a*) the "definitive nucleus," (*b*) the "synergidæ" and egg-cell at the micropylar end of the sac, and (*c*) the "antipodal cells," three in number, at the opposite end. In the definitive nucleus we easily make out the nuclear membrane, the chromatin masses, and the large nucleolus. The latter has a well-defined border, and moreover this border is seen to be of fair thickness, and may at certain points be depressed towards the interior, which is clearer. Obviously in this case the nucleolus has the structure of a vesicle, and it is probable that all nucleoli are of this nature, being filled with a clear fluid of an oily consistency.—*Science-Gossip.*

THERMAL DEATH-POINTS OF BACTERIA.—Different species of bacteria vary greatly in their powers of resisting the action of heat. Speaking generally, pathogenic micro-organisms perish at a much lower temperature than non-pathogenic bacteria. Thus the well-known *B. prodigiosus*, which forms a beautiful blood-red colony when grown on moist bread, cannot withstand a temperature of 58° C. for more than ten minutes, whereas the tetanus bacillus only perishes after six hours at 80° C. The bacillus of tuberculosis is rapidly destroyed in cultivations at 70° to 80° C.; but according to Welch, it can resist in the dry state a temperature of 100° C. for three hours. In milk it has been found to perish after four hours at 55° C.; one hour, at 60° C.; five minutes, at 80° C.; and one minute, at 95° C. (Forster). The spores of bacteria can withstand far higher temperatures than the bacteria themselves. Thus the spores of the tetanus and anthrax bacilli are both extremely resistant to heat, though the latter are destroyed by moist heat at 90° to 95° C. This fact is recognized in the sterilization of food products, which are first heated to a sufficient temperature to destroy the parent bacteria, then left for the spores to develop, and again heated to kill the newly-formed bacteria.

As regards the action of heat upon the toxic products of different bacteria, it has been found that some, like the toxin of tetanus, are decomposed and rendered harmless after a short exposure to a comparatively low temperature; whilst others, like the toxine of anthrax, are only weakened and not destroyed at the temperature of boiling water.

MICROSCOPICAL SOCIETIES.

ROYAL MICROSCOPICAL SOCIETY.—

October 6, C. Baker exhibited a portable microscope on the model of the "Diagnostic" originally designed for Major Ronald Ross's investigation of malaria. It was made of magnalium, an alloy of manganese and aluminium, and weighs but 14oz. He also exhibited a microscope intended for the examination of fractures and etched surfaces of metals. It is provided with vertical illuminator, rack-and-pinion focussing adjustment and leveling-screws to the mechanical stage, now usual in this class of instrument. Messrs. R. and J. Beck exhibited a portable model of their London microscope, which was a very substantial instrument, and was, by the introduction of several ingenious devices, made to pack with the apparatus into a leather case 2¼in. by 4½in. by 9½in. Messrs. Beck also exhibited a centrifuge, made to run at high speed by an electric current. The president brought to the meeting some specimens of the mycetozoa, and gave a brief account of the life-history of this group of organisms. The specimens belonged to a recently-described species, and had been named *Badhamia folucola*, and he had brought some leaves and grass on which were spores for distribution. Mr. C. L. Curties, exhibited a number of mounted specimens of marine zoological objects, accompanied by very full and interesting descriptions. The president gave a *resume* of a paper by Miss A. Lorrain Smith, "On Fungi found on Germinating Farm Seeds." Miss Smith had been assisting him in his work for the Royal Agricultural Society in examining farm seeds in respect to their germinating power. In the course of their observations, Miss Smith had found numerous species of fungi on the germinating seeds, 14 species in all, of which five were new and one belonged to a new genus. Mr. Millett's report on the foraminifera of the Malay Archipelago, was taken as read. Hon. Thos. Kirkman sent some of the fine quills of the porcupine for distribution among the Fellows, who would find them very useful in mounting minute objects.

DEFUNCT.—Professor C. E. Bessey of the University of Nebraska informs us that the Lincoln Microscopical Club has ceased to hold meetings and that there is no prospect of resuming. If we had the right kind of a National Society which conferred Fellowships upon presidents of local societies, it would be easy to keep these little feeders at work.

NEW PUBLICATIONS.

GAGE'S INTRODUCTION TO MICROSCOPIC METHODS AND HISTOLOGY.

In 1901, the eighth edition of this handbook has been issued. It has now reached 300 pages and 230 figures. This brings it along up towards the size and importance of the first edition of Carpenter. It clearly stands at the head of American works of its class. Indeed we know of nothing to compare with it. Presumably it is primarily a reference and laboratory work for Professor Gage's own students at Cornell. Doubtless it is used as well in the histological classes of many other American colleges. But one can fairly ask why this ground was not long ago taken up by some one at Yale, Harvard or Columbia. Since Gage began, perhaps a dozen years ago, he has constantly worked up new material and the frequency of editions suggests that the type must be kept standing in Ithaca and a fresh set of proofs sent up the hill very frequently for emendation and expansion. This thrift is very commendable in a constantly changing and growing field of learning. Unfortunately, the old editions quickly outlaw and second-hand copies are worthless.

Comparison with Carpenter is hardly to be thought of, and yet having searched Carpenter's very latest edition for a description of the ever-mentioned "Society Screw," in vain, we turn to page 64 of Gage's Manual and find the formula exactly and properly quoted.

For the general microscopist, we conceive that Carpenter answers every purpose and is indispensable. But for students the price is important. Carpenter costs $8.00 and Gage perhaps $1.50. Its data is all easily available through a complete and skillful index.

The frontispiece shows the names of all the 17 parts of a microscope in such a way as to immediately inform a beginner of what the instrument is composed. The other 228 cuts are equally clear and instructive. A dozen or more instruments of different make are shown including both domestic and the better foreign ones. We shall refer later to other matter contained in the book.

MISCELLANEOUS.

ASPLANCHNA.--Several species have interesting jaws and teeth. The jaws are dissolved out with caustic potash and mounted separately. The jaws are from 100 to 150 microns long, (25,000 microns make one inch).

LIQUID AMBER.—Liquid amber styraciflua is spoken of as storax, balsamium styracis, styrax liquidée and Flussiger storax. It has a high refractive quality. It is used for mounting diatoms. It always contains a little water which gives it a grayish opacity. This, removed by long standing or heat, it becomes quite transparent. When so dried, it is soluble in alcohol, benzole, chloroform, ether. carbon bisulphide, and volatile oils but not in petroleum ether. When not thus soluble, try xylol and impart a little heat to it. Neither Carpenter or Gage have alluded to it.

Storm Effects.—Maj. H. A. Cummings while in South Africa studied the storms of the Pretoria valley. The air becomes very heated and dry. Storms of severity occurred including whirlwinds of dust, paper, leaves, etc. A nutrient gelatin plate exposed one second in one of these storms developed thousands of colonies of bacteria. The people believed that fever was spread thereby. We may in this way see the power of wind to devastate whole areas of tropical territory.

Vaccination.—In view of such facts as the following, it is very difficult to see how the persons who are crying down vaccination are actuated by anything less than very blind prejudice.

Jenner's discovery was made in 1798. Prior thereto the ravages of small-pox were simply astonishing, one fourteenth of the population of the earth dying therefrom. In a single year of epidemic in Russia, 2,000,000 persons died of it while many more were made blind or otherwise disfigured. The average annual death-rate in all of Europe was 210,000 by small-pox alone. In Great Britian, the deaths were 40,000 in 1798 but immediately upon vaccination being commenced the deaths decreased to 6,000. In Venezuela, in 1812, Balmi exterminated the disease there; in 1813, a million of people were saved in South America by vaccination. Before Jenner's day, great epidemics of small-pox swept off people like so many flies; since, there have been no epidemics and the universality of vaccination has rendered it impossible to see what would occur without it.

That rare and occasional accidents have accompanied vaccination may possibly be true. But he who objects on this account is like the man whose store being on fire would not permit water to be thrown in lest some of the goods should get wet!

CARBORUNDUM.—This is silicate of carbon manufactured at the Falls of Niagara by heat produced by a powerful electric current. A wall about 14ft. long, 7ft. broad and 7ft. high, is built up of nuts of coke, faced outside with loose bricks. Along the centre of the wall runs a core composed of ground coke, mixed with sand, salt, and sawdust. A current passed through the core soon heats it up, and burns the sawdust, which leaves the core porus. Next the salt is decomposed, the chlorine in it finding its way to the outside, the sodium remaining behind and uniting with the sand. As the heat increases, the sodium comes off also in a state of vapor, leaving behind the silica of the sand in a state ready to unite with the carbon of the coke. The union produces carborundum in crystals. After long cooling, the wall is thrown down, and the carborundum is extracted. The name is hybrid between carbon and corundum, which has nothing to do with the substance further than that it is half a grade higher than it is in hardness, being inferior only to diamond. It is largely used for polishing granite instead of emery. When pounded and mixed with clay, made into small bricks, and discs, and fired in a kiln, it makes hones of great abrasive power, and wheels which grind down axles or cut through rods of iron.

For Sale.— A Beck stand with three lenses, very little used. Price $10. Address: G. W. Wilcox, care this office.

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The Ephippium of Bosmina.

D. J. SCOURFIELD.

ILLUSTRATED.

The production of winter or resting eggs in the genus Bosmina has been referred to by various writers on the Entomostraca, but I do not think that any description of the egg's protective covering, which corresponds, of course, to the ephippium of the Daphnidæ, has hitherto been published. As this structure exhibits one feature at least which distinguishes it from the homologous productions of all other forms of the Cladocera, it appears worth while to bring forward the present short paper on the subject.

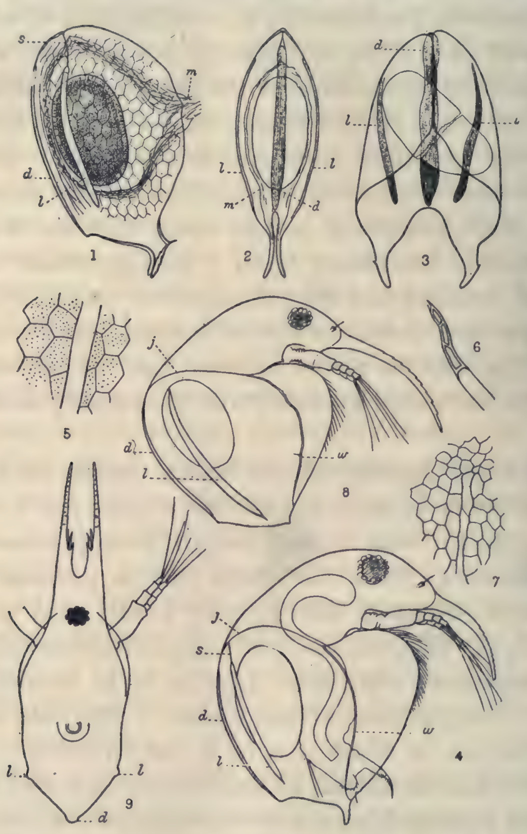
If we examine the recently thrown-off resting eggs of Bosmina longirostris enclosed in its protecting case (fig.

1), we shall see at once that the latter is only a portion of the carapace of the mother. The particular part of the shell which has been utilized for the purpose evidently consists of the valves (as distinguished from the head-shield), with the exception of a rather large piece of their ventral margins. The ventral margins have not wholly disappeared, for the characteristic shell-spines at the posterior ventral angle are still present. At first sight it does not seem that the portion of the shell now enclosing the resting egg has been specially modified. The ordinary faint hexagonal markings on the surface of the valves are quite apparent, and the valves themselves are as transparent as when forming part of the coat of the living animal. Towards the back there is, it is true, a somewhat darker tinge than usual, but this is not very noticeable, and taken by itself would scarcely suggest special modification. Looking more closely at the structure, however, it will be seen that at the back—*i. e.*, along the line representing the dorsal margin of the original valves, there is a distinct increase in the thickness of the chitin, and, further, that there is a narrow, highly refractive band of chitin running somewhat obliquely across each valve from near the anterior dorsal angle to within a short distance of the posterior margin. It is the possession of these lateral thickened bands of chitin which distinguishes the ephippium of Bosmina from all homologous structures.

If one of the lateral bands of chitin be still further examined, it will be seen that it probably represents a modified line of hexagonal areas, forming part of the shell sculpture of the unaltered valve. But all the cross partitions have been obliterated, and the edges of the band have been smoothed so as to show but little indication of the original polygonal arrangement. The extremely minute granulation or pitting of the areas enclosed by the shell markings has also disappeared, for the chitin of the band seems absolutely homogeneous (fig. 5). In continuation of the band anteriorly, there is a slit in the valve which runs up to the anterior margin near the anterior dorsal angle. The edges of this slit are normally in contact, but may be easily separated by pressure. The slit seems to be produced by the falling out of a number of pieces of chitin (fig. 6), exactly in the same way as I have described in the case of the line of separation along the ventral edge of the ephippium and round the valve margins in Leydigia acanthocercoides. The pieces of chitin no doubt represent modified hexagonal areas of the original shell sculpture in the same line as the series which produce the lateral band. In connection with this it may be pointed out that the anterior end is often seen to be separated from the rest of the band by a transverse line (fig. 1). At its posterior end the lateral chitinous band appears to end abruptly in the ordinary shell markings.

In Bosmina longirostris the lateral bands do not project very much beyond the surface of the shell, but in a species (fig. 8) from Upper Lough Erne (probably Bosmina lilljeborgi Sars, although this is perhaps only a variety of B. coregoni Baird), very kindly sent to me by Mr. W. F. de V. Kane, the projection of the lateral bands is so pronounced that they deserve to be termed ridges (fig. 9). The position of the bands in this case is also a little different to what it is in B. longirostris. As will be seen by a comparison of fig. 8 with fig 1 and 4, there is a rather greater distance between the lateral bands and the back of the shell in B. lilljeborgi(?) than there is in B. longirostris; and more important still, the lower ends of bands approach very much nearer to the posterior ventral angle of the shell in the former than in the latter species. I may mention here that the lateral bands are not always so evenly curved as shown in the figures, but that they sometimes exhibit rather abrupt bends—as if in their formation the deposition of chitin had not followed one line of cells the whole way, but had changed from one series to another.

As regards the function of the lateral bands, I would suggest that, in addition to strengthening the ephippium



as they evidently do from their position almost directly over the egg, they may also help to keep the free edges of the valves more closely in contact than might otherwise be the case. Such a result would certainly follow if the ends of the bands, by their elasticity, possessed the power of pressing inwards and carrying the free margins of the valves with them. I do not know whether such a tendency exists, but it is at least very probable.

In addition to having the lateral bands very strongly marked, B. lilljeborgi(?) also shows the thickening along the back as a distinct ridge (fig. 9). That the dorsal thickening is really in the form of a sharply defined band can however, be also seen in B. longirostris, when views can be obtained either from the front (fig. 3) or back (fig. 2).

There is still one other point requiring elucidation, namely, how is it that the ventral portions of the valves become detached when the shell is to form an ephippium? By very careful scrutiny of a female carrying an ephippium and winter egg (figs. 4 and 8). It can be demonstrated that there is a line of weakness, marked by a faint doubly-contoured line on each valve already formed in the exact position where the anterior portion will break away. This line of weakness can be developed into a crack, at least for some portion of its length from the anterior end, by applying pressure. The edges of the crack are quite smooth. The line of weakness does not cross any of the

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EXPLANATION OF PLATE.

Fig. 1. Ephippium of Bosmina longirostris, side view x 150; Fig. 2, dorsal view x 140; Fig. 3. front view (somewhat flattened out of shape), x 140.

Fig. 4. Bosmina longirostris, carrying ephippium and winter egg, x 130.

Fig. 5. A portion of a lateral band of chitin, with adjacent shell-markings (ephippium of B. longirostris), showing how the areas enclosed by the latter are pitted, whilst the band is structureless, x 350-

Fig. 6. Upper portion of a lateral band (B. longirostris), showing the loose pieces of chitin at its anterior end, which apparently fall away and produce the slit found in this position in the ephippium, x 280.

Fig. 7. Portion of shell culture of a specimen of B. longirostris, showing probable early stage in the formation of the line of weakness be tween the ephippium and the ventral portions of the valves, x 180.

Fig. 8. Bosmina lilljeborgi (?), carrying ephippium and winter egg, x 90.

Fig. 9. B. lilljeborgi (?) view from above, showing the projecting lateral and dorsal bands of chitin, x 110.

ordinary shell markings on the valve, but, from the relation of the latter to oneanother on each side of the line it is evident that a considerable amount of alteration of the original shell sculpture has taken place. The probability is that a line of hexagons has been suppressed or rather completely modified to form the line of weakness, and this view is borne out by the arrangement of the shell markings shown in fig. 7, where we seem to have a very early stage of the process exhibited. The one long cell, which lies exactly where a portion of the line of weakness is always developed, has plainly been formed from the ordinary hexagonal markings, because its edges show the characteristic zigzag arrangement, and the crossbars are also just discernible, although almost obliterated. It is somewhat strange that in the specimen from which this was drawn there was no trace of any modification having commenced for the production of the lateral bands and slits. It looks as if the production of a line of weakness may be older in the history of the development of these ephippia than the formation of the lateral chitinous bands. This may very well be so, because among the Lynceidæ, where there is in many cases scarcely any actual modification of the shell, there is almost invariably a line of weakness developed prior to the moulting of the ephippium.

Having now seen how it is that the ventral portions of the valves become so easily detached from the rest of the shell when an ephippium is formed, we may very well ask ourselves why this process should take place. As the phenomenon is so common among the Cladocera there must be some fundamental necessity for it. I think the answer to this question is undoubtedly to be found in the fact that in the vast majority of cases it would be quite impossible for the anterior margins of the valves to be brought into contact if the ventral, and especially the anterior ventral portions of the valves, owing to their very convex nature, remained in position. In other words, it would be impossible for the ephippium to form a closed covering for the egg.

In addition to the outer protective covering which has just been described, there are also some very delicate inner membranes which surround the egg, as indicated in fig. 1. They most probably consist of the moulted inner layer of the shell valves, and, so far as can be seen, do not appear to have undergone any special alteration. The resting egg itself—there is never more than one in any ephippium—is very largely composed of small globules of a dull greenish oily material. At the edges it is slightly translucent, but elsewhere opaque. It can readily be distinguished from a "summer" or parthenogenetic egg by its rather larger size and general opacity. Of course it is enclosed in a special covering of its own, the egg-shell properly so-called. In fig. 3 a broken egg-shell is shown, inside its protecting ephippium, after the hatching out of the young Bosmina.

It will be apparent from the foregoing description that the ephippium of Bosmina much more nearly approaches the homologous structures found in the majority of the Lynceidæ than it does those of the Daphnidæ. It is, in fact, scarcely worthy of the name of an ephippium, as that word is commonly understood, but would be more correctly designated as a proto-ephippium, a term I have already employed for these less highly developed types of protective egg-coverings.—*Quekett Club.*

On the Resolution of Amphipleura Pelleucida with a Dry Lens and Axial Illumination.

A. A. MERLIN, F. R. M. S.

Many members of our Club have been long familiar with the structure of *Amphipleura pellucida* as revealed by oil-immersion objectives of the highest class and aperture. The point to which I now beg to call your attention is the accomplishment of the resolution of normal specimens of this diatom by means of Zeiss's dry 4 mm. apochromat, and 5-6ths solid axial cone from Powell's adjustable apochromatic condenser.

I was led to attack the *A. pellucida* with the above specified optical arrangement through having remarked the great strength of the resolution yielded by some realgar-mounted specimens under the Zeiss 3 mm. of N. A. 1·4 and a solid axial cone of about N. A. 1·2 from an oil-immersion condenser. I must confess that the exact theoretical resolving limit of an object glass of N. A. ·95, as given in the table on page 85 of Carpenter's "The Microscope and its Relations" (Seventh Edition, Edited by Dallinger, 1891), had at the time escaped my memory, otherwise it is extremely improbable that any such attempt would have been made.

It was found, however, that in actual practice the 4 mm., used in conjunction with a 27 compensating ocular, with which eyepiece the image remained perfectly sharp, would steadily show the fine transverse striae on realgar mounts, although the lineation was much fainter than that revealed by oil-immersion lenses of large aperture.

The resolution of valves in realgar having been accomplished, dry and balsamed specimens were next examined, and to my very considerable surprise, both proved resolvable with the 4 mm. and 5-6ths axial cone. In balsam the striae appear as extremely faint, but clean, grey lines of great fineness. Although most faint and difficult, they have been held with perfect certainty for short intervals, slightly averted vision proving of material assistance in this instance.

In order to satisfy myself that the true striae are indeed rendered visible by the 4 mm., a valve has been first arranged to exhibit them under the lens, an oil-immersion being afterwards substituted, when the lines have been found to be identical, and of the same fineness and distance apart with both objectives, the only difference being in the strength of the resolution afforded by them.

The significance of the above results is at once apparent on turning to the aperture table, where we find that N. A. ·96 is given as the *limit* of resolution of the *A. pellucida*; hence it would appear that the Zeiss 4 mm. of N. A. ·95 (nominal), illuminated by a 5-6ths solid axial cone, is in practice capable of revealing structure just within the theoretical resolving limit of a lens of N. A. ·96, and also that this resolution is attainable not only in media of high refractive index, but also in balsam and with dry mounts.

Now the 4 mm., although its guaranteed minimum N. A. is only ·95, as a matter of fact is quite likely to possess a N. A. of ·96, or even one slightly in excess of this, so that theoretically, without any deduction for technical imperfections, it would be just capable of resolving the *A. pellucida*; but that this theoretical limit should be actually attained by a lens with strictly axial illumination, and on specimens mounted in media of both high and low refractive index, cannot but be regarded as a very extraordinary and interesting result, it having been hitherto considered that the transverse striae of the *A. pellucida* are in actual practice only just discoverable with the dry achromatic lenses of N. A. 1 ·0, and that only on specimens mounted in a medium of about 2·4 refractive index when illuminated by oblique light in one azimuth along the valve.

Perhaps not the least interesting and satisfactory outcome of these observations is the indication that a dry lens is capable of working to its full theoretical capacity on balsam-mounted objects, the resolution only becoming more conspicuous in media of higher refractive index.

In addition to the *A. pellucida* many other forms have been recently studied with the 4 mm. and a 5-6ths solid axial cone. The most difficult structural features have not been seen with a lesser cone, but I do not assert that they may not possibly be so resolved, although the results of my observations have strongly inclined me to the belief that, with axial illumination, structure just within the capacity of the lens employed can only be seen with a very large cone. It has appeared to me that closing down the cone, while greatly strengthening the contrast of the coarser, causes the finer detail to disappear altogether, and materially reduces the separating power of the objective. With reference to this matter the following experiment may prove interesting:—Arrange a Cherryfield *Navicula rhomboides*, mounted in a mixture of monobromide of naphthaline and balsam, under a good semi-apochromatic ¼″ of N. A. ·77, and 27 ocular, so that the valve shall lie longitudinally along and on the sharply focussed edge of the lamp flame. With slightly under ¾ cone the longitudinal striae will appear conspicuous throughout the entire length of the valve, while the closer transverse striae, although they may be seen to a certain extent, are far less satisfactorily defined, no thoroughly clear separation being apparent. Now replace the smaller by a 5-6ths cone. The coarse strongly-defined longitudinal striae disappear, and at the first glance all structure may seem to have disappeared with them, but a little careful scrutiny will reveal the presence of a faint dotted resolution, the transverse divisions of which are as fully and cleanly shown as the longitudinal.

I am aware that the results dealt with in this paper can not meet with general acceptance until they receive confirmation at abler hands than mine, nor indeed would it be desirable that they should be so accepted, involving as they do important theoretical considerations, until independent practical experience shall have placed their truth beyond doubt.

The subjoined notes on some of the forms lately examined with the 4 mm. may be of interest. A very large central solid cone has been invariably employed in conjunction with either Gifford's or the beautiful new acetate of copper screen.

Nitzschia curvula Sm. This diatom is mounted next to *Amphipleura pellucida*.

Grun. Moller's balsam type slide. Transverse striae extremely faint and difficult. A delicate object even with N. A. 1·3 and 1·4.

Nitzschia linearis and *N. obtusa* Sm. In balsam. The former very faintly resolved into transverse striae, the latter not so difficult. Dr. H. Van Heurck, in his "Synopsis des Diatomees," gives *N. linearis* as having 27 to 30 striae in 0·01 mm. (25·399 mm. = 1 inch), and *N. obtusa* 26 to 27 in 0·01 mm. *N. sigmatella* Grun., is given at 25 to 26 striae in 0·01 mm., but the specimen of this form on the type slide has much finer structure than *N. linearis* and *N. obtusa*.

Nitzschia sigmoidea Sm. Moller's dry "Probe-platte" —25½ to 26 striae in 0·01 mm. according to Van Heurck. This is remarkably easy with the 4 mm., the striae presenting a beaded appearance. They can be certainly seen with the 12 mm. apochromat of N. A. ·65, so do not probably, in this instance, exceed 55,000 to the inch. A specimen in balsam is also very easy with the 4 mm.

Nitzschia sigma Sm. Van Heurck gives 22 striae in 0·01 mm. Distinctly dotted in balsam, and very easy in mixed monobromide of naphthaline and balsam.

Grammatophora oceanica Ehrenbg. = *G. subtilissima*. Moller's dry "Probe-platte." Resolved into transverse striae. Van Heurck gives 30 striae in 0·01 mm. for the *G. oceanica* var. *indica* Grun., and 30 to 31 for the *G. oceanica* var. *novaezeelandiae* Grun. Some specimens of *G. subtilissima*, however, are finer, running at about 88,000 to the inch.

Navicula crassinervis. Striae 34 to 35 in 0·01 mm. according to Van Heurck. This has proved a most delicate object with the 4 mm., both dry and in realgar. With N. A. 1·3 and 1·4 realgar mounted valves are sharply resolved into dots, but the transverse striae have alone been seen with the dry lens.

Hyalodiscus subtilis. In a mixture of monobromide of naphthaline and balsam. Dotted structure on outer zone well seen, although faint and difficult near the edge of the disc. In balsam mounts the structure appears still fainter, but nevertheless may be traced nearly to the outer edge, where it runs at about 76,000 to the inch.

Surirella gemma Ehrbg. In realgar the beading has been seen beautifully defined with the valve arranged longitudinally on the sharply focussed edge of the lamp flame. Specimens mounted dry, in balsam, and in quini, dine, have been also examined, but their complete resolution has proved a much more difficult matter.

Colletonema vulgare. Moller's balsam type slide. This has been most carefully studied with the 4 mm. The resolution is very faint, and requires particularly exact focal adjustment, but when once seen it can be held fairly steadily without any great difficulty. Dr. Van Heurck writes of this diatom, "Stries fines, delicates, les moyennes faiblement radiantes, les terminales paralleles-environ 34 en 1 c. d. m.; les stries medianes plus fortes, plus ecartees, 24 en 1 c. d. m. et plus radiantes."

Navicula major. Moller's balsam type slide. The full resolution of the structure of the bands on the hoop of this diatom is by no means easy, even with the Zeiss 3 mm. apochromat of N. A. 1·4. Notwithstanding this, the resolution is carried very far by the 4 mm., the striae appearing remarkably black, crisply defined, and well separated, their beaded nature being quite recognizable, although not so fully revealed as with the oil-immersion. On this specimen the striae alone are just visibly separated by the 12 mm. apochromat, 5-6ths axial cone, and a Huyghenian eyepiece magnifying about 45 times, the 27 compensating ocular not proving sufficiently powerful for the purpose with this objective.

Larval Water-mites on Aquatic Animals.

C. D. SOAR, F. R. M. S.

In a paper on Hydrachnidae, read in 1896, (*Journ. Q. M. C.*, Vol. VI., p. 318), I mentioned that I wished to make myself familiar, as far as possible, with the larval forms of water-mites, and by a systematic search among all kinds of our pond-life to find out upon what creatures these larvae occurred, and if the same species was always parasitic on the same host. Since then I have collected and examined a great many aquatic insects, etc., but the results so far have been rather poor. They have, however, been considered sufficiently interesting to put on record.

One of the most common aquatic insects upon which to find the larvae of Hydrachnidae is *Corixa geoffroyi*. I have found a great number of these, and some of them I have succeeded in keeping alive long enough to allow the red globular water-mite larvae to drop off and become free-swimming. The latter always turned out to be the nymphs of one of the species of the genus *Hydrachna*.

In September, 1898, on the Norfolk Broads, I took a number of water-boatmen, *Notonecta glauca*, afflicted with the red globular parasites. I brought some of them home, but, although I kept one or two alive for a long while, I did not succeed in getting any of the larvae to arrive at the next stage. In the spring of 1899, I again paid a visit to the same neighborhood, and succeeded in capturing some more water-boatmen. A number of these were brought home alive, as before, and this time I was successful in getting some of the red globules attached to the legs and body of the water-boatmen to become free-swimming in the nymph stage. These again all turned out to be a species of the genus *Hydrachna.* By comparing the size of the red larvae found on *Notonecta glauca* in the autumn of 1898 with those found on the same form at the same spot in the spring of 1899, I have come to the conclusion that the water-mite larvae remain attached to their hosts for a whole season—namely, from the summer of one year until the spring of the next—and the fact that those I found in the autumn did not undergo any alteration helps to strengthen this opinion.

I have further found two small yellow pear-shaped larval water-mites on the larval form of a gnat, and also one on an Ephemera larva, but I have been unable to rear them.

I have found also that the water-scorpion, *Nepa cinerea*, is a favorite host with some species. But I have not been able to keep any alive long enough to find out to what species of water-mite the larvae belong. In Epping Forest I took a specimen of *Ranatra*, literally covered with red water-mite parasites of all sizes. This I succeeded in keeping alive until ten specimens became free-swimming. They all turned out to be nymphs of *Hydrachna globosa* Geer. But the most curious find, perhaps, in this connection, has been a small fish from a pond on Earlswood Common with two larval forms of water-mites attached, which I take to belong to a species of *Arrenurus*.
Quekett Club.

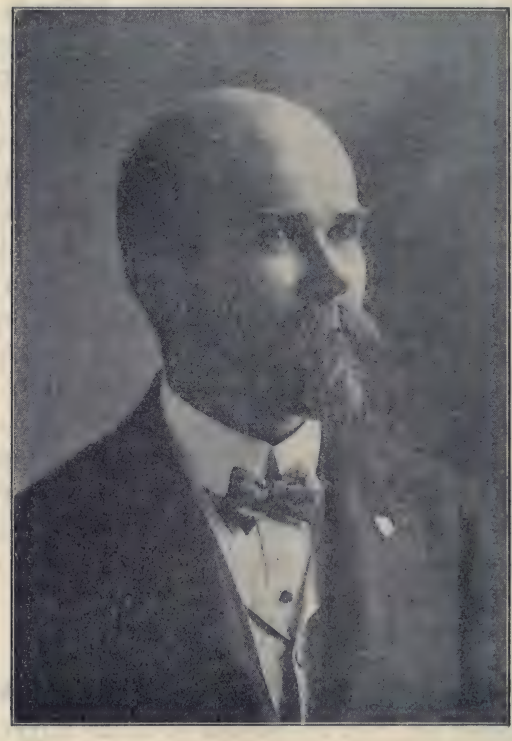
Viewing Diffraction Spectra.

J. REINBERG, F. R. M. S.

It is a matter of common knowledge that the diffraction spectra, which an object under the microscope gives rise to, may be observed by removing the eyepiece and looking down the tube. But unless the eye is kept perfectly steady, which is difficult, they shift and change about. For this reason Dr. Johnstone Stoney recommended looking at them through a pinhole near the eyepiece, a method which I followed for some time. This, though it does away with the shifting, reduces the light very much. It is also possible to view the spectra by screwing an objective into the lower end of the sliding draw-tube, with eyepiece in position at the upper end, and then focussing down on to the upper focal plane of the objective, but this is a cumbersome business. Latterly I have employed a method which is exceedingly convenient and efficient. The diffraction spectra, as is known, are not only formed in the focal plane of the objective, but are reformed just above the eyepiece, and may there be viewed by means of a lens. So I have mounted in a short tube the objective of one of the cheap toy microscopes, which is in effect a lens of about a ¼ inch focus stopped down to an actual aperture of about 1 mm. The diffraction spectra ocular, as we may call it, when placed on the ordinary eyepiece of the microscope, on the cap of which it fits shows the spectra splendidly, magnifying them at the same time. It gives plenty of light, and the spectra can not shift. I can strongly recommend the arrangement to those who cultivate the useful habit of studying the spectra, *i. e.*, the optical effect produced by na object, as well as the object itself.—*Quekett Club.*

Sketch of J. D. Whelpley.

Born at Battle Creek, Mich., May 24th, 1861, Dr. Whelpley has just turned 40. To enumerate even the larger portion of the things which he has done during the comparatively few years of his existence would fill a volume, so no attempt will be made in this slight sketch to touch his career except at the high places. To show the strength of heredity it may be well to state in the first place that the subject of this notice is descended from a family of physicians, his father, grandfather and great-grandfather having practiced medicine. From his maternal side, the Doctor inherited a love for literature. His mother's family produced many politicians, his maternal great-grandfather having been one of the framers of the constitution of Wisconsin, the inkwell from which that famous document was written being now in the Doctor's possession. This ancestor was once a candidate for governor of Wisconsin, on the losing side. The famous Salmon P. Chase was a relative of Dr. Whelpley's mother.



Young Whelpley's education was aquired in the schools of his native state, including the college at Otsego. When hardly more than a boy he tried his hand at teaching a country school, with what success may be judged from the act that he is yet a teacher. Before moving to St. Louis in

1881 to take advantage of the opportunity presented by the city to acquire a college education in pharmacy, the future president of our leading pharmaceutical organization had received his first instructions in bottle washing and window cleaning in Michigan, and had also practiced pharmacy in Illinois.

Applying himself to his studies with his usual diligence, the student was graduated by the St Louis College of Pharmacy in 1883 with the highest record which had been made at that institution up to that tine, and won the gold medal for general excellence. While at college his irrepressible predilection for teaching compelled him to form a quiz class —the first in the history of the college—of which he was master. Upon his graduation he became a regular quiz-master of the college and has continued his connection with the teaching faculty ever since, being now professor of microscopy.

When but sixteen years old, Mr. Whelpley began to read medicine, but did not go about it seriously until many years later. In 1890 he was graduated by the Missouri Medical College, ranking third in a class of 117, notwithstanding the fact that he was looking after outside interests while carrying on his studies.

Five years before he had gained his degree of M. D. Dr. Whelpley began to teach in the medical college mentioned. After his graduation he became a member and secretary of the faculty. For ten years he filled the chair of histology, physiology, and microscopy, and then, upon the merging of Missouri and St Louis Colleges into the Washington University, he became, and still is, professor of materia medica and pharmacy in the latter. He is also professor of the same two branches in the dental department of the university. The Doctor, or Professor, as he should be known in this connection, has a faculty of being able to impart to his students any knowledge he possesses. He is popular with the boys, and is able to be on the most friendly terms without in any degree losing any of his own or of their respect.

In addition to his other work as a teacher the Doctor delivers free popular lectures on scientific subjects during the winter.

This many-sided man under discussion is a member of the American Medical Association, as well as of his state and city societies, and also of the local Academy of Science, and Historical Society. He was a delegate to the Pharmacopœial Convention in 1890, and again in 1900, being elected secretary of the convention the latter year. He is also active in the alumni associations of the colleges of which he is a graduate, and is well up in Masonry and Odd Fellowship.

The literary work of the new president began when he was young. He acted as correspondent for the newspapers while still a boy, and also edited a college paper. Soon after going to St. Louis he became the pharmaceutical editor of the St. Louis Druggist. The paper became the National Druggist, and he became the editor. In 1890 he left that paper and assumed entire charge of Meyer Brothers Druggist a position which he still holds. He has published Curtman's Lecture Notes, and Whelpley's Therapeutic Terms. His contributions to the statistical knowledge of the use of the metric system have been large.

In 1892, Dr. Whelpley and Miss Laura Spannagel, the daughter of a well known St. Louis banker, were married.

While making no public pretense to scientific attainment Mrs. Whelpley took a post-graduate scientific course at Cornell and is well versed and much interested in her husband's work. Their pretty home is a veritable museum of archæology and microscopy. In it is a large library of microscopical works, about 8,000 rare microscopical specimens, a large and unique collection of Indian relics and like historic and prehistoric things. This home is open to students of science, some coming from Europe to visit it and see archæological specimens which cannot be duplicated in any of the museums of the world.

A Murder Trial in Washington.

A Mrs. Bonine is on trial for the alleged murder of James Seymour Ayres in his bed-room at 2 o'clock one morning last May. She admits that she alone was with him at the time of shooting, but claims self-defence. Curiously, it is to her interest to prove blood on her garments to an extent that will show that there was a hand to hand struggle. Her expert, Dr. Sterling Ruffin, testified as follows:

Q. What are the principal tests for blood spots?—A. There are three tests in particular—the Wyeth, microscopic, and Haeman-crystal tests.

Q. Are all in vogue at the present?—A. Yes, sir. Allare in vogue and are recognized by the scientific world as reliable.

Q. Are they all conclusive?—When applicable; yes, sir.

Q. Did you make any experiments as to whether there was any blood on Mrs. Bonine's wrapper?—Yes, sir.

Q. Where?—A. In Dr. Schaeffer's office.

Q. Who was present?—A. Dr. Schaeffer and Dr. Carroll at one time and Dr. Schaeffer, Dr. Carroll, and yourself at the other time.

Q. Did Dr. Schaeffer observe the experiment?—A. Yes, sir.

Q. What did you find regarding the condition of the wrapper?—A. I found several rips and tears.

Q. Did you inflict or enlarge any of these?—A. No, sir; not by the fraction of an inch.

Q. Did you examine the wrapper for blood spots?—A. Yes, sir. I took pieces of the wrapper from several places for the purpose of examining them.

Q. Where from?—A. I took one piece from the front and one from the back of the lining of the green velvet yoke and various other specimens. Some consisted of the velvet and some of the brown material of the wrapper.

Q. What was the result of your examination of the two specimens taken from the yoke?—A. I found blood on both.

Q. What tests did you use?—A. I used the Wyeth, microscopic, and Haeman-crystal tests.

Q. What did they show?—A. Each showed there was blood on both specimens.

Q. Were all of the tests applicable and conclusive?—A. Yes, sir.

Notes on Microscopy.

M. I. CROSS.

The Microscopical Examination of Metals.—It is a little singular that a study which has assumed such great importance as the examination of steel and iron under the microscope has done during recent years should not have received any treatment whatever in so exhaustive a work s the new edition of "Carpenter on the Microscope." It is a highly technical and important subject and has become an absolute essential in all iron and steel works. In fact, there is probably no factory of standing that is not equipped with suitable instruments both for observing and photographing.

Although much information regarding the chemical constitution of the metal is disclosed by the microscope, it is in ascertaining the mechanical properties that the special value of the examination lies.

For instance, the structure of steel varies with the different degrees of hardness and the amount of heat to which it has been subjected, and it is possible to gain definite information concerning the suitability of the metal for the purposes for which it is to be used by means of the microscope.

In the manufacture of guns the microscope is invariably resorted to, and it can be definitely determined before the manufacture is proceeded with whether the metal is suitable for the purpose, or any defect has taken place in the heating or quenching which would render the gun unsafe or unsatisfactory.

Engineers can detect flaws, blow-holes, defective welds, etc., and in many ways are able in an early stage to avoid the trouble incident to the use of imperfect metal in the finished article. Microscopes for the exclusive purpose require no substage apparatus or mirror, and although the completed stand is usually employed, the demand has become sufficiently marked for makers to produce special instruments in which a large mechanical stage is provided, but no fittings beneath the stage. Among these are Reichert, of Vienna, C. Baker, of London, and Queen, of Philadelphia. In all of these the vertical illuminator plays an important part; some observers preferring the pattern with a prism, others the cover-glass reflector, while many employ both, finding that each pattern is advantageous according to the structure examined.

When the light and illuminator have once been adjusted, it is important that no movement of the body of the microscope takes place, or the illuminating would have to be re-set. To obviate this, these special microscopes by Queen and Baker have rackwork focussing adjustment to the stage, together with levelling screws, so that any want of parallelism in the piece of metal may be corrected, and the face set at right angles to the plane of the objective. It will be seen from this that the subject has received careful consideration, and that suitable means are available for accurate work.

The metals themselves that are to be observed have to be prepared with great care; the processes are technical, and vary with the purpose of the examination. Generally a small sample block is taken, and cemented to a pieee of glass. It is then ground and polished on a series of emery papers, and finally with a very fine polishing material such as rogue, until no scratches can be detected.

Although the harder portions can be in many instances seen at this stage, chemical means have to be resorted to, to differentiate the structure, the action being unequal on the different constituents, and it is by the treatment with such chemicals—nitric acid and liquorice juice being among the most important—that the chemical composition is detected. Many of the constituents have received distinctive names, among them being:—

Ferrite, which is the name given to pure iron.

Cementite, representing the iron carbide in steel.

Pearlite, a mixture of cementite and ferrite.

Martensite, the structure of quenched steel.

Austenite, a name given to structure which is produced in steel in which there is a high proportion of carbon.

There is vastly more to be learned of this interesting subject, and it is a field in which the amateur could with interest and profit make investigations.

MULTIPLIED IMAGES IN DIATOMS.—Happening to hold a needle over the mirror of the microscope while a slide of Triceratium was under examination, I noticed that its point appeared dimly in each of the interspaces, and on racking the body of the microscope slightly upwards in same manner as is necessary when observing multiplied images in the cornea of the eye of a beetle, I noticed that it became distinctly sharp. I then placed a piece of black paper cut in the shape of a cross on the mirror, and with a 1-6 in. objective saw it sharply displayed, although on a much smaller scale than in the eye of beetle.

Experiments were then made with Coscinodiscus and other diatoms, and the same result was shown. This would seem to indicate that these interspaces are lenticular in shape, and it may be that with this knowledge further light may be shed on the complex question of the ultimate structure of some of the Diatomaceæ.

Subscriptions for 1902

The published price of this Journal for 1902 will be $1.20. From this, a discount of twenty cents will be made for prepayment coming from the subscriber direct or through any agent or intermediary the subscriber may select. Whenever we have to send bills we shall charge the published price $1.20. We prefer not to deal through middlemen and therefore cannot hereafter, as many periodicals do, make a larger price in order that middlemen may get their allowances. We wish to net a dollar in advance without discount or trouble of sending bills and cannot put a premium on round-about methods which benefit neither the subscriber or the publisher. Yet as "agents" will be used and if used ought to be remunerated we publish the price at $1.20 and so authorize them to charge that price, Out of it they must remit to us one dollar.

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Professor Rudolph Ludwig Karl Virchow.

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Professor Rudolph Ludwig Karl Virchow.

GEO. N. ACKER, M. D.

With Frontispiece.

The distinguished german pathologist, anthropologist and politician completed his eightieth year on Sunday October 13, 1901. The great event was celebrated in Berlin and most of the medical centers of the world on Saturday October 12. Virchow was born in Schivelbein, a small town in Pomerania in 1821. He was educated at the gymnasium, and graduated in medicine at the University in that city in 1843. After graduation he undertook the study of pathology and soon became assistant to Froriep and prosector at the Charite. With his friend Reinhardt, he founded, in 1847, the *Archiv*, which has become the most important medical periodical in the world and ever since has borne his name. Compelled in 1849, on account of his democratic tendencies, to give up his position and residence in Berlin, Virchow removed to Wurzburg where he continued active work in pathological anatomy, and made for himself such a name that the faculty and government in Berlin recalled him in 1856 to the chair of pathological anatomy. A new pathological institute was established for him, and he has remained director of this institute and professor of the university ever since. The technique introduced into the autopsy-room by Virchow and his published account of it became the standard for post-mortem work all over the world. Before this time accurate autopsy reports were scarcely known. He was very strict and severe with the members of his class when conducting an autopsy, requiring them to be exact in the use of terms and accurate in describing what they saw. He would open the body from the chin to the pubes with one sweep of his butcher's knife and then make the dead man tell his secrets, so searching was the scrutiny. He was always pleasant and ready to aid his students and above all was a constant stimulus to accurate observation though he made great advances in the study of pyemia, leukemia, thrombosis and embolism by special researches on these subjects, yet he will always be best known as the founder of so-called "celular pathology." In his long famous work on this subject he led back pathological processes in greater completeness than had ever been attempted before, to alterations in the elementary constituents of the body—the cells. His great work on tumors can be consulted to day with great profit. In anthropology and ethnography, Virchow is as well and favorably known as in pathology. His contributions to the science of public hygiene are among the most notable of his works. For many years he has occupied a seat in the Reichstag and has taken a most active part in the government in connection with medical and veterinary affairs. He has always stood firm for principle and right.

Images of Diatom Structure.

W. BALFOUR STOKES.

The advantage of using a wide solid axial cone of illumination lies mainly in the blotting out of those perplexing and numerous interference effects so apparent when a narrow or oblique beam of light is employed.

With a wide cone, therefore, difficulties of interpretation are greatly reduced; but with many objects we may still have two images, from which we must select the true one. It is easier, however, to select from two than from a dozen.

A simple diatomic structure, for instance, if examined by means of a narrow or oblique beam of light, will present, at different focal positions, many images or effects, not one of which can be called trustworthy; but with a wide solid axial cone we obtain two images only, totally opposite in appearance and at different focal positions, but both of which are conceivably trustworthy representations of the only possible reality.

These two last images I will describe as follows:

	Silex.	*Edges and perforations.*
Upper focus ..	dark	bright.
Lower focus ..	bright	dark.

The upper image is usually known as the "white dot" image, diatom perforations appearing as white dots.

The lower image is known as the "black dot" image, diatom perforations appearing as black dots.

The question is: What is the true image? A diversity of opinion seems to exist.

Most microscopists would, I think, select the "white dot" image, but Mr. Nelson prefers the "black dot," while Mr. Comber suggests that the true image should lie between the two.

The "white dot" image would be preferred by many because, with directly transmitted light, one naturally expects a perforation to appear brighter than the substance surrounding it; and I would point out that opaque materials present in this image the only appearance one would expect, viz. black.

Mr. Nelson preferred the "black dot" image because he was able to see fine differences and minute details in individual "black dots" of Pleurosigma formosum, which were quite invisible at any other focus.

I do not know Mr. Comber's reasons for regarding the true image to exist between the "black" and "white dot" images.

The true image, if it exists, must lie at the true focus. But if we divide our objects into zones, may not spherical aberration allow, within limits, a true focus to each zone?

Now, the conditions under which the "black" and "white dot" images are seen as separate and distinct entities are those in which the objective is divided into zones.

When an axial cone is used, the objective is divided into two concentric zones, the central zone occupied mainly by directly transmitted light, the peripheral zone occupied only by indirectly transmitted (diffracted) light.

An annular cone (full cone and a central stop in the condenser) also divides the objective into two zones; but in this case the diffracted light occupies the central, the directly transmitted light the peripheral zone of the objective.

A "half-way" annular cone (a two-thirds cone with a central stop half the size of the diaphragm opening) divides the objective into three zones, of which the central and peripheral zones are occupied by diffracted light only, and the intermediate zone is occupied by direct light.

Examine an ordinary balsam-mounted diatom (not a Pleurosigma) by these three methods, and, when focussing down, you will find the positions of the "black dot" and "white dot" images to be as follows:

Axial cone	"white dot." "black dot."
Full annulus	"black dot." "white dot."
Two-thirds annulus ..	"black dot." "white dot." "black dot."

There is, as the last method shows, an image for each zone of the objective, and on examining the results we see that apparently the "white dot" image is formed by the direct light, and the "black dot" is formed by diffracted light.

What would be the real effect of spherical aberration? I have been told that most objectives are spherically under-corrected. If this be so, the foregoing suggestion is strongly supported: for one must bring an under-corrected objective nearer to the object in order to utilize the periphery of the lens. Compare this with our three previous experiments, and agreement will be found.

To return to our question: Which is the true image? Let us deal with Mr. Nelson's deductions from the examination of Pleurosigma formosum. This diatom differs from the majority of diatoms in this respect: When an axial cone is employed, the "black dot" image is above the "white dot," the very reverse of what occurs with the great majority of diatoms. This, in my opinion, points to a difference of peculiarity in the structure of P. formosum.

I suggest that the perforations of this diatom are more or less silted up with foreign material. When the late Mr. C. Haughton Gill charged the minute perforations in diatom valves with opaque metallic sulphides, the "white dot" image of the perforations was changed to a "black dot" and the "black dot" to a "white dot"; but no such changes took place in the appearances of P. formosum, the "black dot" image being merely intensified. Does not this point to the probability of the correctness of my suggestion—viz. that the perforations of this diatom were already filled up?

Again, the difficulty in getting an image of a "postage stamp" fracture through the perforations of this diatom was thought by Mr. T. F. Smith to be due to the existence of a layer of beaded structure, which would present the appearance of circles bulging outwards; but I imagine that the clinging of any silting-up material to the broken-into openings would account satisfactorily for such appearances.

The minute appearances which Mr. Nelson discovered within the black dots of this diatom may be considered, not as pieces of silex or other material, but as irregular openings through the silted-up perforations. They are bright at the upper focus and dark at the lower focus when an axial cone is employed; that is to say, they behave as do the imagines of ordinary diatomic perforations.

Pleurosigma formosum is either optically or structurally peculiar. I cannot imagine the former, so I suggest the latter.

The possibility of the former would raise doubts as to whether the microscope were at all a reliable instrument; but my suggestion that P. formosum has its perforations silted up explains all former difficulties in the interpretation of the images of this diatom, and, besides, makes the exception confirm a method for the interpretation of such images as we are considering. And what is that method? It is a comparison of the relative positions and appearances of the images of unknown structures with those of the images of known structures.

For instance, assume the under-corrected objective and the axial cone, and we notice that clear diatomic perforations, fractures, grooves, etc., are bright at the upper focus and dark at the lower focus; while the silex, ribs and thickenings of silex especially, are dark at the upper focus and bright at the lower focus. You may have a peculiar line on a siliceous valve to interpret. According to the rule, if it be bright above and dark below, it is a fracture, groove, or tube; if it be dark above and bright below, it is a rib or other increase in thickness. I believe this rule to be applicable to all objects examined under these conditions.

But which, after all, is the true image? The answer must await a definition of a true image. If an image be only true when it has some macroscopic analogy, then only the "white dot" image is true. If, however, an image be true when it leads to a truthful interpretation of structure, then the "black dot" image is also true. Both images, in fact, agree in contour and detail with the object—that is, as far as aperture diffraction effects will permit.—*Quekett Club.*

Note on Red Rain Dust.

G. C. KAROP.

I received for examination from Captain C. J. Gray, a small sample of Red Rain Dust, collected by him in Melbourne, Victoria, on Dec. 28th, 1896.

The material was a cinnamon or brick-dust colored powder in a very fine state of division. Under the microscope it was seen to consist almost entirely of extremely minute amorphous particles, sparsely intermixed with some larger aggregations of the same, which in xylol balsam and by transmitted light appeared of a dull orange tint.

On going over the preparations field by field, a few other inorganic inclusions and still fewer organic bodies were to be found—the latter consisting for the most part of diatomaceous fragments, but in one or two cases entire valves; broken sponge spicules, some very much eroded, and also some curved, hayaline objects, pointed at one end and possessing scattered, secondary blunt spines. The exact nature of these last is to me uncertain; they may be sponge spicules, or siliceous plant hairs.

The diatoms were generally too much fragmented for certain identification, a minute Surirella and a species of Fragilaria alone being entire. The central portion of what is clearly a Stauroneis, and bits of Epithemia valves were, however, distinguishable by their markings.

The dust itself is pretty certainly a ferruginous clay, and no effervescence or visible effect was produced by acids. The few inorganic inclusions are minute greenish grains of (?) chlorite or (?) glauconite; but these, of course, may be quite adventitious.

In the absence of any knowledge of the geological features of the Melbourne district it is impossible to say whether the material is of local origin or not. In any case both it and its included remains are almost ubiquitous; the diatoms, etc., may have been rolled about for centuries or aeons. Reduced to impalpable powder by sun, rain, and wind, it has, perhaps, been borne aloft by some violent storm and travelled round the world; or, on the other hand, it may have been deposited by the first shower not very far from its birthplace.

The phenomenon, while hardly common, is yet not of very infrequent occurrence. This very year it has appeared in Southern Italy and other places, and, of course, given rise to numerous communications to the newspapers. The first really scientific exposition of the causes of this startling phenomenon, was Prof. C. G. Ehrenberg's work entitled "Passat Staub und Blut-Regen. Ein grosses organisches unsichtbares Wirken und Leben in der Atmosphaere. Mit 6 colorirten Kupfertafeln," published in the Abh. Berliner Akad., Berlin, 1849, and other communications on the subject submitted to and published by the same Academy in 1862, and later.

The two most common origins of so-called Blood-rain are, firstly as above—viz., extremely finely comminuted particles of red earth with various inclusions, raised by some tornado and carried, it may be, for immense distances from its place of birth; and, secondly to the sometimes extraordinary development in a very short space of time of the lowly protophyte known as Spherella (Protococcus) pluvialis, which, besides its usual green, in certain peculiar and not very well ascertained conditions sometimes assumes a red color, and was in this state formerly differentiated as Hæmatococcus. Either this and allied forms such as, for instance, the hardly separate one known as S. nivalis, causing "Red-snow," or Bacillus prodigiosus, or other chromogenous bacteria, and some of the Palmellaceæ, as P. cruenta, occasionally appear with extreme suddenness, and among the unlearned give rise to no little alarm, and to dire prognostications of war, famine, and sudden death.—*Quekett Club.*

Double Image Disks and Complementary Interference Colors.

J. RHEINBERG.

Some years ago I was making experiments with multiple-color illumination, using discs above the objective; and, in making one or two such discs out of colored glass, Messrs. Zeiss, of Jena, observed a displacement of the image of the central portion of the color disc relatively to that of the peripheral portion. They then made a double-image color disc on purpose.

A prism-shaped disc of green glass had a central hole perforated in it, in which was inserted a smaller disc of red glass with plane parallel surfaces. Consequently the light passing through the prism-shaped part is shifted slightly as compared with that passing through the centre, and we get a separate image formed by each part. That formed by the central portion is an image the same as if the aperture of the objective were cut down to the same size. No fine detail would be seen with an objective of such small aperture, and the image becomes a so-called "dioptric" one. Provided the cone of light from the condenser does not exceed this small aperture, nearly all the light which passes through the prism-shaped portion of the disc will be light which is diffracted by the object, consequently the image formed by this part is a so-called diffraction image. With a double-image disc this diffraction image is spurious, inasmuch as all fine periodic structure will be doubled owing to the absence of the dioptric beam as a component.

A double-image disc made in this manner, but of clear uncolored glass throughout, ought to further test and exemplify a point in the theory of interference colors—viz., when the dioptric image of a diatom showed color due to interference, the diffraction image of the first order should show the complementary color.

I have now such a disc, and the result, by examining a slide of Actinocyclus ralfsii under the microscope, has fully borne out the anticipation. With these diatoms, which show such varid and vivid coloring, it is very striking in effect to see the two images of each diatom lying next to one another in precisely complementary tints.

BIOLOGICAL NOTES.

L. H. PAMMEL.

BACTERIAL DISEASES OF PLANTS.—During the summer Dr. Erwin F. Smith distributed separates of some most valuable contributions to a knowledge of bacteriological diseases of plants constituting a reply to Dr. Alfred Fisher's remarks on the existence of diseases of plants produced by bacteria. In addition to the large amount of original matter presented here on the presence of bacteria in plant tissues and the pathological changes produced by them. The paper contains a large number of excellent figures. While some

European investigators like Dr. Fisher may still be in doubt as to the correctness of the conclusions arrived at by Dr. Smith, those who are familiar with his work know how thoroughly and carefully it has been done can not doubt the general status of this question as regards diseases produced by bacteria. The papers are commended for a careful perusal by those who are interested in getting an insight into this important question. (Centralblatt f. Bakt. u. Parasitenk. II Abt. 5: 271, 279, 810. 7: 88, 128, 190.)

NUCLEAR DIVISION IN FULIGO VARIANS.—Prof. W. A. Harper does not agree with Rosell that there are two different kinds of nuclei in this plant. These differences are due to inequalities of fixation. Karyokinetic figures can be found oriented in all possible ways to the cleavage furrows. (Bot. Gazette 30: 218.)

PATHOGENIC ASPERGILLI.—Dr. T. A. Rothwell has made experiments with A. niger and A. fumigatus, both are pathogenic but the A. fumigatus may produce death and A. niger never did in his experiments.

BOTANY DURING THE NINETEENTH CENTURY.—The St. Louis Academy of Science is devoting a series of meetings to discussing the progress made in science. This subject was treated by Dr. Trelease of the Missouri Botanical Garden. Though necessarily treated somewhat concisely, he presented it in a lucid and brief manner as one only can who is familiar with every phase of the subject. The topics discussed are systematic botany, systems of classification, evolution and classification, morphology and anatomy, physiology, protoplasm, ecology, applied botany, popularization and publication, botany in the United States. (Trans. Acad. Sci. St. Louis, 11: 125–142.)

FUSARIUM EQUINUM.—Victor A. Novgard describes a new species of Fusarium that is causing an epidemic skin disease of horses on the Umatilla Indian Reservation. More than 60 per cent of the 6,000 horses on the reservation are said to be affected. The disease manifests itself through severe itching and loss of hair over almost the entire body. The fungus occurs in the hair sacs and sebaceous glands. The spores are half moon, spindle or sickle shaped. (Science N. S. 14: 898.)

CLEISTOGAMOUS FLOWERS.—Sablon who has studied the cleistogamous flowers finds that the hypodermal layer of cells in the anther was large, thin-walled, and contained very little protoplasm, but at the upper end of the anther both the epidermal and hypodermal layer of cells are very small and contain an abundance of protoplasm with a large nucleus. (Rev. Gen. de Bot. 12: 308.)

SCANDINAVIAN BOTANICAL GARDENS.—Dr. Rydberg has made an interesting report on the Scandinavian Botanical Gardens. We take this interesting note in regard to the bald cypress of the south. "This tree, a native of North America, reaches but the 39° lat. on the lower Delaware, but is perfectly hardy at Lund near the 56° lat. and is also grown, although with more difficulty, at Gothenburg, on the 57°40′ lat. Liriodendron, the tulip tree, which reaches the 42° lat. with us, is grown at Lund with less success, but fails altogether at Gothenburg. Of course neither is hardy at Stockholm, Upsala or Christiana." (Jour. N. Y. Bot. Gard. 2: 129.)

THE ANATOMY OF CHRYSOMA.—Prof. Francis E. Lloyd makes an interesting discussion on Some Points in the Anatomy of Chrysoma pauciflosculosa in which the following conclusions are reached: 1. The leaf of Chrysoma pauciflosculosa is bifacial, isolateral, and of unique structure. 2. Two kinds of hairs are present, which agree with the morphological types found in the Compositæ, as defined by Vesque. 3. The stomata correspond closely in structure to those of the majority of halophytes, as described by Warming in his Halofyt Studier, but possess a more specialized inner entrance. They are provided with accessory cells

(Nebenzellen), which are not, however, very regularly placed. 4. The arrangement of the mesophyll possibly stands in mechanical relation with the stomata. 5. The perennial shrubby character of the plant and its peculiar leaf anatomy separate it definitely from the genus Solidago." (Bull. Torrey Bot. Cl. 28 : 445–450. Cont. Dept. Bot. Columbia Univ. 184.)

MILK OF WILMINGTON AND PLATT'S CHLORIDES.—The Bacteriological and Pathological Laboratory of the Delaware State Board of Health publishes bulletins that contain in addition to valuable resumes of European and American work, matters that the Board of Health through Prof. Chester and Albert Robin have investigated. No. 9 contains an interesting account of analysis of milk sold in Wilmington. From the results of investigations obtained, the authors conclude that Platt's Chlorides fail to kill typhoid bacilli by direct contact in 20 minutes.

TRANSMISSION OF TUBERCULOSIS.—The American Medicine for October 26, Nov. 2, 1901 publishes a summary of investigation on the subject of the Transmission of Tuberculosis through Meat and Milk by Dr. John J. Repp of Ames. The writer concludes that meat is highly unfit for food when the animal is highly tuberculous but is safe for food when the animal is only slightly tuberculous, especially so if the meat is well cooked and the tubercular tissues are eliminated. In regard to milk, the milk of a cow with tuberculous udder is always dangerous for food unless it is well sterilized. The milk of tuberculous cows with healthy udders is sometimes dangerous for food unless well sterilized. Tuberculous cows may be kept for breeding purposes provided that they are isolated, and they may be slaughtered for food under conditions reached in this paper. He regards the bacilli of cattle pathogenic for man.

BACTERIA OF SEMI-DESERT REGION.—Prof. John Weinzirl publishes a summary of his investigations of the bacterial flora of the semi-desert region of New Mexico, with especial reference to the bacteria of the air. The following important conclusions are arrived at: 1. The air bacteria of our semi-desert region presents a somewhat limited flora; but this is found to be widely distributed, due undoubtedly to the high winds which sweep uninterruptedly over our wide stretches of nearly barren mesas. 2. The actual number of bacteria contained in the air is not as large as in fertile and cultivated regions, but the number is not as small as is popularly supposed. 3. It would seem to follow from the above that sanitary measures and precautions should receive practically the same attention here as elsewhere. Disease-bearing materials, such as infected clothes, sputum, etc., should be carefully disinfected or burned. 4. Many of the species show highly-colored colonies; these belong mostly to the group micrococci. The flora is characterized by its inertness toward sugar media, and its failing to peptonize gelatin. 5. Apparently none of the species have been previously noted.

Notes on Microscopy.

M. I. CROSS.

MICROSCOPES IN SCHOOLS.—During the last few months, the development of the system of "Nature teaching" in elementary schools has led to enquiry as to the most serviceable form of microscope for further developing the subject. In Scottish schools in particular, this work is to become a part of the regular curriculum, and it has been said that every school will be provided with at least one microscope, so that the senior scholars may pursue their studies in a thorough manner. In England encouragement is being given by the issue of Teacher's Leaflets of "Nature Knowledge," by the Agricultural Education Committee.

One of the main objects attempted to be achieved by these leaflets is to lead the teacher to cultivate the faculty of observation, to trace cause and effect, and to become acquainted with life-histories and processes of evolution and development. If students acquire the habit of observation, they will quickly learn to think, and an added interest will be imparted to their studies by bringing them into actual touch with the secrets which the microscope can alone reveal.

It would seem almost a pity to give the scholars a compound microscope at too early a stage; pages could be written on the unnoticed structure which can be seen with a pocket lens, and it would be well that the work should be graded, and that before a compound microscope is used the worker should have acquired a facility with the pocket lens.

There is no doubt that this new study will receive encouragement, will be appreciated by the scholars and grow to large dimensions, and it will be for all the microscope makers to anticipate the requirements by providing suitable instruments of sound but plain construction, and at a sufficiently moderate price; in fact, in a degree the success of the scheme so far as microscopy is concerned depends on the willingness of makers to do their part. It is impossible to foretell the influence which such teaching may have on the future of the country scientifically, and it is not improbable that it will in time to come bring an army of workers into the ranks of microscopists, and serve to re-create the interest which it is considered by many is dormant among amateurs at the present time.

FOCUSSING ATTACHMENTS TO PHOTO-MICRO. CAMERAS.—Many ideas have been formulated for making an effective connection between the microscope fine adjustment and the long rod which actuates it from the end of the photomicrographic camera. These have consisted principally of an endless band passing round the milled head of the microscope and a similar head attached to the rod of the camera; or a friction gear, in which a wheel shod with india-rubber is arranged to engage with the microscope milled head; or a cord carried over the microscope milled head and over pulley wheels on either side of the base board having weights at the two ends, practically another form of friction movement. In practice the endless band has been the favorite, but it has possessed one drawback—it cannot be readily detached from the microscope.

This difficulty was overcome by the cord with weighted ends. A very neat and simple fitting has been contrived by Mr. E. B. Stringer, which overcomes the obstacle with the endless band. The usual milled head of the camera rod, around which the cord is passed, is mounted on a frame the lower portion of which fits into a sleeve, permitting of the rod on which the milled head is carried being tilted forward when the band is to encircle the fine adjustment milled head, or to be removed; the band is then made taut by setting the fitting vertical again, a clamping screw being provided for securing it. In this position the long camera rod connects with it and actuates it.

It may be mentioned that two or more milled heads of different sizes will often be found useful on the camera rod, for they will permit of the rate of movement being increased or diminished as may be desired.

A NEW SUBSTAGE CONDENSER.—Several writers have advocated the use of a good low-power Substage Achromatic Condenser, but nothing that really filled the gap was obtainable until the introduction of Mr. C. Baker's new condenser. Zeiss's Achromatic Condenser was right so far as it went, but it had several disadvantages. It was large—too large—and restricted the movements of the mechanical stages, also it yielded an aplanatic aperture of less than ·70, yet the fact of its having a power of ½-inch caused it to be appreciated, and largely used. Messrs. Watson & Sons have just introduced a new condenser having a power of 4-10 inch, and a numerical aperture of ·99, which is practically totally aplanatic. This will be found a great auxiliary to the range of condensers, especially as it possesses a sufficiently large field-lens, and is not so bulky in the mounting as to obstruct the moving plates of the mechanical stage. There is quite a comfort in using a condenser of this power with objectives of low and medium magnification.

OBJECT MARKER.—A very neat accessory, and one that is frequently required, is a means of indicating by a mark on the specimen cover exactly where a particular structure that has been observed can be found again. Leitz makes such a fitting which replaces the objective after the required portion of the object has been found. The front portion of the marker is then brought into contact with the object, and a mark is made upon it which indicates for the future the position of the particular structure. Its cost is very small.

Notes on Microscopy.

F. SHILLINGTON SCALES, F. R. M. S.

QUEKETT MICROSCOPICAL CLUB.—The 389th ordinary meeting of the club and first of Session 1901–1902 was held on Friday evening, October 18th, at 20 Hanover Square, W., Mr. J. G. Waller, F. S. A., Vice-President, in the chair. New members were balloted for. The Secretary read a list of books and periodicals added to the library since the last meeting. The additions to the cabinet were announced and acknowledged. These last included some slides of plague bacillus found or cultivated under various conditions mounted and presented by Mr. Pound, of the Stock Institute at Brisbane. Mr. Scourfield read a paper by Mr. A. Ashe on "Two-speed Fine Adjustments." This was a description of several forms of fine adjustment, having two milled heads rotating on the same axis, by which a medium or an extremely slow movement could be obtained at will. Some new forms of "differential screw" movement were employed to this end. The method recommended for the Continental form of microscope had been arrived at independently and put into practice by Herr Reichert of Vienna. Another form which was exhibited was employed, at the author's suggestion, by Messrs. Beck. Mr. Scourfield read a paper on "Hydra and the Surface Film of Water," and showed, by means of an ingenious model and by drawings on the blackboard, how minute objects, though slightly heavier than water, could remain in contact with its surface. This result was obtained by means of a waxy or water-repellent substance coming into contact with the surface film and forming a capillary depression. The author pointed out how many aquatic creatures, though undoubtedly heavier than water, could yet remain at the surface without the aid of movement or air-bubbles. The hydra holds to the surface by its basal disc, and the author had been able to see a number of hyaline strands which were apparently secreted from the disc. The strands, though difficult to discern, were seen to extend considerably, thus making a "capillary depression" of comparatively large area. The author believes that this stringy secretion, intermixed as it is with globular and ovoid bodies, is formed by the breaking-up of the ectodermal cells of the basal disc. In the ensuing discussion Mr. Karop described an analogous secretion in the Gregarines. Mr. Morland gave instances of the unexpected stresses the film of water will bear. Mr. Rousselet read a paper on "Triarthra brachiata, n. sp." This was an account of a new species of rotifer, and a specimen was exhibited under a microscope. In the ensuing discussion, in reply to a question by Mr. Scourfield, Mr. Rousselet said that he had not met with an instance of a rotifer making use of the surface film in the way that did the Hydra and some Cladocera in fact, the surface film was a death-trap to rotifers. Rotifers provided with long spines, like Triarthra and many others, were at a disadvantage in that respect. Mr. A. A. Merlin's paper "On the Spermatozoon of the Rat" was held over for the next meeting. Formal proceedings then terminated. At the conversazione many objects were exhibited, including a model to show the support of the surface-film of water, exhibited by Mr. Scourfield. This was a piece of match weighted with a pin at one end sufficiently to make the match sink; the light end of the match was smeared with vaseline. On bringing the match from below to the surface of the water it hung supported from the "surface film." Messrs. R. & J. Beck, Limited, exhibited a "Pathological" microscope with Mr. Ashe's two-speed fine adjustment, and Mr. R. T. Lewis exhibited a slide showing the "Sense-organ on the palpus of male Anopheles." This was a curious projection on the extremity of the palpus, free to move in all directions, even inwards. It is not found on the common gnat, but is seen on the palpi of ticks. Colored drawings were also shown. Mr. Rousselet exhibited a slide of Lophopus crystallinus, beautifully mounted by himself, and Mr. Earland exhibited a slide showing trifurcate sponge spicules.

MANCHESTER MICROSCOPICAL SOCIETY.—The monthly meeting of this Society was held on Thursday evening, November 7th, at the Grand Hotel, Manchester. Mr. Mark L. Sykes, F. R. M. S., read a paper on "Evolution in Butterfly Scales." Mr. Sykes said that he had selected for the purposes of his communication some of the specimens illustrated in his paper on "Natural Selection in the Lepidoptera," published in the "Transactions" for 1897, as the illustrations would be available to the members, and would enable them to see the close resemblances which these butterflies bear to one another. In whatever direction the mimicry may tend, whether in simulation of inanimate objects such as leaves or twigs or moss, for concealment from their enemies on the one hand or to enable them to secure their prey on the other, in mimicry of conspicuously marked or highly colored inedible by edible species, in resemblance between two or more equally distasteful but entirely different species, or whatever purpose the mimicry may serve; it seems that the resemblance is in outward appearance only. Although the similarity in color, pattern, and markings may be so close as to be almost identical, microscopical examination of the wing scales of these insects shows that the details by which the likenesses are brought about may be, and often are, widely different. The specimens from which the examples were taken fall under two groups of mimicry, that of Muller and that of Bates. The Mullerian form of mimicry is that in which two or more highly colored, conspicuously marked, or peculiarly shaped butterflies, all inedible and distasteful to the insect-eating animals, are so closely alike as to be easily mistaken one for the other. These by their similarity in appearance afford each other mutual protection by dividing between them the total number destroyed by the young Insectivora of each season in learning what is and what is not good for food. The Batesian mimicry is that in which certain conspicuous and nauseous species that the young birds, etc., quickly learn are distasteful, are simulated by others which are not very nauseous, but which have acquired the color-markings of inedible forms and are thereby protected. Amongst the former are the Heliconinæ and Acræinæ, all of which include amongst their members numbers of highly-colored species conspicuous for their markings in red, yellow, black and blue, with intermediate tints or shades, and which are easily distinguished in their surroundings. In the latter are included butterflies of nearly every sub-family, and some of the diurnal moths, and both are found nearly all over the world. Yet, on examining with the microscope the scales of the wings of these mimetic butterflies, it will be found that, so far from the similarity in superficial appearance being similarity in detail and pattern, there is a wide diversity in scale structure and arrangement. The scales vary not only in numbers, but in size, color, and form, and this is the case even where one inedible species mimics another. Mr. Harry Yates exhibited under a number of microscopes tow-nettings from various localities, chiefly Naples, Port Erin, and Stromness. The results of these gatherings, collectively termed plankton, he said differed very much according to locality and time of the year. The state of the weather may also account for the presence of specially abundant species. The young stages of nearly all forms of marine life are to be found in floating condition, at the mercy of tides and currents, thus spreading the species over wide areas.

C. BAKER'S ENGINEERING MICROSCOPE.—This instrument has been specially designed for the examination and photography of metals. It contains several distinctive characteristics. As it is intended for the examination of opaque objects exclusively, no means of substage illumination is provided, and even no stage aperture. Opaque objects to be examined with moderate powers can be illuminated in the ordinary way by means of a bull's-eye, a side reflector, or a lieberkuhn, but with high powers a vertical illuminator must be used. This is simply a collar placed above the objective with a small hole at the side through which a strong light from the lamp is directed, the size of the hole being adjusted by means of a diaphragm. Within the collar is a disc of cover-glass set at an angle of 45°, which without materially interfering with the vision reflects the light down through the objective to the object and back again to the eye. In some illuminators of this type a prism covering half the field of view takes the place of the disc of cover-glass. The body-tube has the usual coarse and fine adjustments; but as it is inconvenient to move it when once the adjustments have been made, the stage is provided with an independent rack-and-pinion focussing adjustment, as well as with mechanical stage and levelling screws for the object under examination. The eyepieces are of the R.M.S. No. 3 gauge. The workmanship and finish of this microscope are of the highest class. The foot is of the solid tripod form, the back leg of which might, however, with advantage be extended a little more, with a view to gain increased steadiness in the horizontal position. The price of the stand alone is $80.

NEW "DIAGNOSTIC" MICROSCOPE IN "MAGNALIUM."—In addition to the foregoing microscope, Mr. Charles Baker has also submitted for our inspection a "Diagnostic" microscope (SCIENCE-GOSSIP, vol. vi., p. 182) constructed almost entirely of "magnalium," an alloy of manganese and aluminium, and resembling the latter metal in appearance. The total weight is only fourteen ounces. The price of the microscope when in this alloy is $27.

BECK'S PORTABLE "LONDON" MICROSCOPE.—Messrs. Beck have recently added a portable model to their list of London microscopes (see S.-G., vol. vii., p. 184), in which the back leg of the base slides in, whilst the side legs fold together, the stage itself being removable. In other respects the instrument is the same as the ordinary model, fitted with draw-tube, coarse and fine adjustments, also rack-and-pinion sub-stage, but with the additional advantage of packing into a leather case 9½x4½x 2¼ inches in size. The price of the stand, without objectives, eye-pieces, or condenser, is $30. The "London" microscope is now made in a cheap vertical form, without joint for inclination or sub-stage, and with plain brass stage with wheel diaphragm, but with graduated draw-tube, spiral rack-and-pinion coarse adjustment, micrometer screw fine adjustment, and double mirror, for the sum of $13, complete in mahogany case.

BAUSCH AND LOMB MICROTOMES.—Messrs. the Bausch and Lomb Optical Company have recently issued a new catalogue of microtomes, and have submitted to our notice several of the instrments listed therein. The most important of these are the Minot Automatic Rotary and Minot Automatic Precision Microtomes, of elaborate construction, and consequent high price, which are more especially designed for advanced work. The laboratory microtomes of this firm are of equal excellence of design and workmanship, if somewhat less elaborate in form. In these the object to be cut is raised by a screw with a feed adjustable from two to sixty micra, the adjustments being so arranged that any desired cutting angle or length of stroke can be had. The knife itself is carried on a v-shaped block. A microtome of this description, with feed operated by hand-lens, is listed at $50, complete with knife and holder. A smaller microtome is of a similar design, but the object is raised by a micrometer screw with a pitch of 5 mm., with a graduated head divided into a hundred parts; so that each graduation has, therefore, a value of 5 micra, and there is no automatic feed. This microtome is specially designed for students, and costs, with knife and holder, only $24. A very substantial table microtome, somewhat of the Leitz type, costs $13. Amongst new designs may be mentioned a simple microtome for freezing with carbon dioxide gas, which can be attached to the gas cylinder.

MOUNTING WEB OF SPIDER.—I found no difficulty in mounting spiders' webs in balsam. I painted a strip of varnish across the two ends of a clean slide, and held this flat against the web; the slide was covered with it, and the oblong torn from the web was held in position by the varnish. I added two or three strands of the big stays or cords supporting the web from the tree, and then left the whole to dry. A few days after I poured on the centre a little balsam dissolved in chloroform, then dropped a cover-glass on it, and left it to dry. The thinnest lines are visible, and the dirt (soot) on them more so. The hawsers, as I call them, show their multiple structure well. The lines which compose the cross threads of the net are smallest, but quite clear and simple. They are as visible in balsam as flax fibre is, and there is no tendency so far to dissolve.—*F. W. Payne, Grove Park, S. E.*

R. & J. BECK'S NEW 1-14th-INCH OIL IMMERSION OBJECTIVE.—Messrs. R. & J. Beck, Limited, have sent for our inspection a new 1-14-inch oil immersion objective. The extra magnifying power over a 1-12th inch objective is of service in bacteriological and malarial investigation, whilst the price is the same. This lens is made with numerical apertures of 1·0 and 1·25, and sold at $20 and $25 respectively. We have tested the first of these and can speak favorably of its performance; the corrections are excellent and the working distance ample, whilst the aperture is sufficient for the requirements mentioned, which do not need great aperture. We sometimes question if, in the reaction against objectives of high initial magnification without corresponding increases of aperture, we have not overlooked the advantages that mere magnification will give us in certain investigations—a magnification in excess, at any rate, of the 1-12th inch immersion objectives that are the highest powers now generally asked for, and to which special attention therefore has been given by opticians. The working distance certainly becomes a difficulty with higher powers, but it is a mistake to suppose that an objective does not deteriorate in its performance when used with a high-power ocular to gain the needed magnification.

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Examination of the Eye.

C. W. DODSON, M. D.

[Notice of a book entitled "A Guide to the Microscopical Examination of the Eye by Professor R. Greeff of Berlin, translated by H. Walker of Glasgow. Published, 1902, by Blakiston, Son & Co., Phila. at $1.25 pp. 171, 12 mo. revised ed.]

The Microscopic preparation and examination of the eye and its fluids both normal and abnormal is made most fascinating by the elaborate and exceedingly practical directions compiled into a beautiful little hand-book. Of course, one must have a freezing microtome, microscope costing about $40 but not neccessarily an oil-immersion lens. Ordinary slides being too narrow, those 32x62 mm. with cover-glasses 25x25 mm. are preferred. The author considers Leitz's stand equally as good as Zeiss's, while cheaper. As a great number of stains are to be made, it is economy to have scales and buy the materials at low prices. But little other apparatus is needed.

Directions are given for procuring eyes from living subjects or those just dead, as changes take place almost immediately after death. Hardening must be done at once. But as many advantages are lost by hardening, the study of fresh specimens is also recommended. Hardening shrinks and packs the cells close together. But fresh tissues require certain preparations.

The various liquid exudations are taken up on a platinum loop, transferred to slides, covered and examined for cholestearin crystals, fatty degenerate cells, etc. which hardening solutions would dissolve. These cover-glass preparations are often stained, washed, dried and permanently mounted in Canada balsam. Cover-glass preparations are also made from soft tissues such as gliomata. Firmer tissues, like sarcomata of the chorioid, require teasing in liquid by needles; or if still firmer first soak them 24 hours in alcohol, or Muller's fluid.

The author describes at length, eleven methods of hardening, as follows: In alcohol, Muller's fluid, Erlitzki's fluid, corrosive sublimate, picric acid, picric acid sublimate, formalin, osmic acid, nitric acid, platinum chloride, Herman's solution. The advantages and disadvantages of each method are known. Erlitzki's fluid consists of 50 bicromate of potash, 10 sulphate of copper to 1000 of distilled water, works quicker than Muller's but produces shrinkage. Formalin was first used in micro work by Blum. It must be remembered that formalin undergoes chemical changes when exposed to light and air. Use it in the dark. The same is true of osmic acid which is very volatile. It brings out the karyomitotic figures and renders fat globules very dark. Hermann's solution is a mixture of 15 solution of platinum chloride (1 per cent), 4 solution of osmic acid (2 per cent), 1 glacial acetic. It preserves nuclear and protoplasmic structures excellently.

For imbedding, the celloidin method is better adapted than the paraffin method. Photoxylin is a new substance which is used in the same way as celloidin, dissolves immediately, is more transparent and is less stained by hæmatoxylin. In the form of wool, photoxylin is very explosive, dissolves in alcohol and ether mixed and absorbs water from the air.

Weigert invented and Obregia has modified a method of obtaining serial sections from celloidin imbedded material and this the author describes at length.

Work with hæmatoxylin is, of course, considered in great explicitness. As this stain may be easily overdone, directions are given for the treatment of overstained sections, such as by the use of ammonia-alum, or of one-tenth per cent hydrochloric acid. A beautiful counter stain is got in using an excess of hæmatoxylin and following with weak nitric acid and weak liquor potassæ to produce a bright blue. Tripple staining may also be secured with Van Gieson's stain or by the Biondi-Heidenhain method. The former produces brownish-yellow, bright red and violet; the latter, blue, green and red. As expected, double staining with carmine is done in several ways. Safranin also gives important results.

Among the special stains for special tissues are described: Weigert's stains for medullary sheaths; Pal's stain for the same; Marchi's method for same; Nissl's stain for ganglion cells; Weigert's stain of neuroglia; the orcein process for elastic fibres; Heidenhain's demonstration of karyomitotic figures; and Benda's iron-hæmatoxylin method.

A most valuable chapter relates to the demonstration of definite substances and tissue elements, such as fatty degeneration, calcareous degeneration, cholestearin, mucoid, hyaline, and amyloid degenerations, fibrin, iron, copper and mercury in the eye.

It is surprising to consider what a large variety of most interesting slides exhibiting a great variety of stained tissues can be made from the eye. This field has not been worked by amateurs and such slides are rare as they would be useful. Cholestearin crystals appear as thin transparent rhombic plates often notched at the angles. A little sulphuric acid colors them orange, or later a beautiful rose-red, Lugol's solution of iodine (1), iodide of potassium (2), and water (100), colors the crystals dark brown which can be changed to bright blue by a mere trace of sulphuric acid. (Too much acid dissolves the crystals.) The various kinds of degeneration yield material for stained objects in abundance. Fibrin is shown in an intense blue color by means of Weigert's specific stain made of gentian-violet. By fine particles of iron getting into the eye and becoming dissolved therein, tissues become laden with this metal. This can be demonstrated by coloring a fine blue color by means of Perls' reaction with Berlin blue and alum-carmine. The beautiful iron particles are perfectly demonstrated. By the same reaction, copper, if present, is shown to be colored brown through the precipitation of ferrocyanide of copper. Likewise, mercury can be condensed and precipitated in bluish-black crystals making an elegant slide. Indeed, the beauty of a collection of slides, produced by the clearly-described processes of Greeff, is not inferior to any in biology unless we except the always-to-be-excepted diatoms.

A second and greatly improved era in staining has of late been inaugurated by a trio of Europeans consisting of Comillo Golgi of Pavia, P. Ehrlich of Berlin, and Ramon y Cajal of Madrid. Instead of painting cells they impregnate cells with coloring matter and thus differentiate from each other different kinds of cells. Only in this way can details be secured. This new era has come within the past 20 years and its importance is not yet generally recognized by users of the microscope. This process of impregnation may last for two months. In the case of the retina and optic nerve this method has yielded pictures which are astonishingly complete. The cells are revealed even to their finest processes and appear as if drawn diagramatically. Some of the drugs used in impregnation are bichromate and corrosive sublimate; bichromate and nitrate of silver; bichromate of potash, osmic acid and nitrate of silver. Osmic acid is costly which has led to the substitution of formalin in many cases.

Golgi discovered this impregnation but Cajal discovered a double impregnation. Golgi's method is best applied to the delicate neuroglia cells of the optic nerve which cells it demonstrates perfectly. Cajal's method is used on the retina which yields beautiful pictures. He soaks small pieces (5 mm. in dia.), for three days, in formalin and bichromate of potash, then, for three days more, in rather less than one per cent solution of nitrate of silver.

Endothelium, nervous plexuses and ganglion cells are beautifully demonstrated by the Intra Vitam Methylene blue method. This was started by Ehrlich and has been improved by Kallius, Apathy, Bethe and especially by Dogiel. It is complicated and requires wit and skill but yields the grandest of results.

For the injecting of blood vessels with coloring matter as soon as an animal has died by bleeding, there are now two very useful "masses." The red consists of warm gelatine-carmine which by the addition of acetic acid changes the cherry-red to a brick-red opaque tint. The blue mass involves four solutions: sulphate of iron, prussiate of potash, oxalic acid and gelatine. A deep blue stain is obtained thereby. If only the eye is to be injected, it can be done by puncturing with a hypodermic syringe charged with Berlin blue. If used upon the posterior layers of the cornea, the lymphatic spaces are clearly exhibited when tangential sections are to be made from the back of the cornea and mounted.

Calcareous materials are so often deposited in the eye that a process of decalcification has been worked out. Slight calcification is destroyed by Muller's fluid during the process of hardening. Greater calcification is resolved by a month's immersion in Muller's fluid. Action is hastened by the addition of nitric acid and a weekly change of the liquid. But for quick and effective destruction of the lime salts, Haug prescribes nitric acid (15) absolute alcohol (300) salt (1) and pure water (150) as a solvent.

Pigment epithelium of the retina can be bleached out by means of euchlorine, in which the tissue is soaked 48 hours, first having been hardened in Muller's fluid and washed for 24 hours. Euchlorine is made from chlorate of potash and strong hydrochloric acid and must be kept in the dark to avoid the passing off of chlorine gas which would render the euchlorine inert. There is also a way of bleaching the sections individually after cutting. This is by Leopold Muller's method (1895). It depends upon exposure to sunlight in peroxide of hydrogen or in chlorine water. Or, it may be done by E. Fick's method with bichromate of potash and dilute sulphuric acid. Alfieri bleaches in a solution of permanganate of potash exposed to sunlight followed by oxalic acid. Bleaching renders all sections very fragile so that they must be handled with a section lifter and not with needles. After bleaching away the pigment stain with Heidenhain's Iron-hæmatoxylin, beautiful slides may be made.

Greeff has not failed to present three methods of preserving eyeballs for museum specimens or for future use. There are (1) the gelatine method, (2) the dry method, and (3) the formalin method. Medical or general museums can now exhibit a great number and variety of preserved specimens taken from hundreds of species of animals, both normal and abnormal. The eye can thus have a natural setting which removes the ghastliness of alcohol specimens. Greeff gives illustrations of how this is done.

In a very lengthy appendix he describes: (1) the cornea and its layers, (2) the iris and chorioid, (3) the lenses, (4) the zonula ciliaris, (5) the retina, and (6) the optic nerve. This, of course, includes the method of demonstrating all the parts and notes on the comparative anatomy of the eye in animals.

This would make an excellent laboratory course, for Greeff has explained a hundred or more different methods of treating tissues in order to bring out the æsthetic and pathological results. When a student has thoroughly practiced all herein indicated he will have a wonderful collection of slides, facility for making preparations, and ability to work on any other kind of tissues. His instincts will, by that time, guide him safely into unexplored fields. Especially would this be true in places where one has access to abatoirs and the dissecting rooms of medical colleges, but of course the eyes of the lower animals are constantly obtainable. Every large city has a pound where cats and dogs are killed by the score every week. A Washington poundmaster boasts of having slaughtered 20,000 dogs since he entered the business many years ago. No house-wife is properly qualified until she had drowned some score of kittens while every cat will secure for you the eyes of birds, mice, chickens, and rats. The insects will come to you of their own accord and peddlers will bring the eyes of fishes. Once you have entered upon collecting, all nature seems to set to work to throw its bounties into your lap. Objects come unsolicited and so unobtrusively that we forget the fact that in a single month more material comes than we had seen before in a lifetime and more than we can possibly make any use of in our most lavish endeavors. Nature itself is merciless in taking life and sending materials to her devout worshipers. There is no need or excuse for man to subject himself to the opprobrium of cranks and of Societies for the Prevention of Cruelty. When Nature is ones ally, he may laugh at S. P. C. A.s composed of sickly women.

It is really astonishing and should be humiliating to the crowds of American "professors" who teach and putter, putter and teach, but never discover anything to compare with European discoveries. Of these hundred and one methods cited by Greeff, I am sorry not to be able to find a single one bearing the name of an American; of the hundred or more citations from books, pamphlets and periodicals, in Greeff's book not one is from American sources,—all are European and practically all are Continental. Our English brethern are first reflectors of Continental knowledge and we are secondary mirrors! Yet greater facilities, more money and larger salaries are lavished upon our "professors" by state and sectarian colleges or by national and state governments than are at the command of European savants. Why is this thusly?

The Economic Sea-weed, Porphyra.

This genus contains so much jelly that it is used for food and as an article of commerce by Chinamen and Pacific Coast Indians. A student in the University of California has included in a thesis eleven species of Porphyra, viz., laciniata, leucosticta, perforata, nereocystis, naiadum, amplissima, miniatum, tenuissima, abyssicola, variegata, occidentalis, as found on the Pacific coast. Hus's article occupies 64 pages of the Proc. Cal. Acad. Sci. II, 6. Those interested in the jargon of rejected synonyms, localities, habitat, etc., should see the paper.

The descriptions of sporocarps and antheridia are very full and complete for each species. He relates his microscopic manipulations with the specimens as follows:

On account of the fact that in most of the species of Porphyra examined the jelly makes up a large part of the frond, considerable difficulty was encountered in preparing the necessary number of mounts. The specimens collected fresh were either dried or killed on the shore in Flemming's mixture, strong and dilute, one per cent chromic acid, one per cent, two per cent and five per cent chrome alum, Wilson's corrosive sublimate, one per cent formalin and alcohol. Of all these, Wilson's solution, formalin and alcohol, gave the best results, the others either shrinking the specimens or failing to fix them. As soon as this point was settled, all except the latter three were discarded. In some cases, as in P. naiadum, formalin gave the best results; while in others, Wilson's solution was to be preferred.

The necessity of the salt of a heavy metal to fix the jelly became apparent when rough dried and herbarium specimens were examined. The first ones to be studied were dried specimens of P. perforata which, when soaked in water, resumed their original outward form. But when the same process was tried with others, especially with P. variegata, it was found that the jelly dissolved very readily, so that some means had to be resorted to by which the specimens might be preserved in good condition. At first, glycerin, twenty per cent glycerin in water, and twenty per cent alcoholic glycerin were tried, but without good result. When a saturated aqueous solution of corrosive sublimate was used cold, this answered all requirements in every case except that of P. variegata, where it was necessary to use a boiling saturated aqueous solution.

Of all species of which fresh material could be obtained sections of from three to five microns in thickness were made on the Minot microtome. To prepare the material for this purpose, small parts of the frond of which a section was desired were taken from the Wilson's solution in which they had been left for about six hours, or from the formalin in which they had remained an indefinite time, and placed in ten per cent alcohol from which they were dialyzed into 95 per cent alcohol. The specimens remained in 95 per cent alcohol for an indefinite time, but never less than twenty-four hours. The parts of the frond were then folded in small bundles of about one-fourth of an inch or less square and one-eighth of an inch in thickness; after which they were transferred for three hours to 100 per cent alcohol. From this they were placed in a mixture of equal parts absolute alcohol and bergamot oil. In this they remained two hours, as they did in the bergamot oil to which they were transferred. From the bergamot oil they were passed into 45° paraffin, a mixture of equal parts of 45° and 54° paraffin, and 54° paraffin, being during that time placed in a water-bath which was kept at a constant temperature of 56° C. In each of these they remained from two to three hours.

After this they were imbedded in 54° paraffin and on cooling were ready for cutting. In most cases good results were obtained. This method was extremely useful in determining the number of divisions in the antheridia, which in comparatively thick razor sections with pith was very difficult to do. Razor sections were usually stained with eosin, while microtome sections were stained with acid fuchsin or with safranin. Of the two, the latter gave the better results.

In a single case, that of P. naiadum, a double stain, methyl-blue-safranin, was used with exceedingly gratifying results. The slides were passed from xylol into absolute alcohol, 95 per cent alcohol, and a saturated alcoholic solution of safranin. Here they remained for about half an hour, after which the slides were placed for five minutes in 95 per cent alcohol to which some drops of methyl-blue, enough to give the alcohol a deep blue tinge, had been added. After this they were transferred to absolute alcohol, xylol, and finally mounted in Canada Balsam. On examination the slides showed that while the cushion-shaped base of P. naiadum stained a bright red, the tissue of the hostplant, Phyllospadix, was stained blue, as were the chromatophores and cell-contents of P. naiadum. In some cases, where the slides had remained longer than five minutes in the methyl-blue the young fronds emerging from the cushion-shaped bases were stained purple. The ribbon was fixed on the slides with albumen, and floated out in water and placed on the top of the water-bath where the slides remained till dry.

As regards mounting media, dilute glycerin jelly and Farrant's Medium gave excellent results. While the former can be used to great advantage in preparing surface views, the latter is to be preferred where razor sections are to be mounted. It appears to have a clearing action on the tissues. Great care must be taken to wash out all corrosive sublimate in alcohol to which some potassium iodide is added, while hardening preparatory to cutting, since even the slightest trace of mercuric chloride will after a time attack the mounting medium and destroy the preparation.

Progress of Microscopy in 1901.

F. SHILLINGTON SCALES.

Microscopy is largely the handmaiden of other sciences, and the wide fields of research covered by the term have been so much specialized, that a review even of a single year's work is an impossibility in the space at our disposal. In Zoology, Botany, and Medicine the use of the microscope plays an increasingly important part, whilst its applications to manufactures and industrial uses beome more notable each year. Especially is this the case with regard to practical problems in connection with the metallography of steel and of metal alloys. Workers like Sir W. C. Roberts-Austen, Mr. J. E. Stead, and others, have elevated the microscopic examination of such crystalline structures into almost a distinct branch of science.

The science of Bacteriology, however, is one that is of necessity universally accepted as coming peculiarly within the domain of microscopy, and it is in this department that many of the most interesting developments have taken place during the past year. Most noticeable of all was probably Professor Koch's startling statement at the recent British Congress on Tuberculosis, which called forth swift and vehement protest. Professor Koch, whilst incidentally giving his adhesion to the theory that tuberculosis is, in contradiction to popular opinion, practically non-hereditary, expressed the opinion that bovine tuberculosis was in reality not communicable to man, because he had entirely failed in communicating human tuberculosis to cattle. The converse is manifest, but though Professor Koch observed that it was impossible to give this question a direct answer because the experimental investigation of it with human beings was out of the question, offers were almost immediately made by various persons to submit themselves to the test. We do not envy Dr. Koch his dilemma.

Equally important has been the progress of the investigations into the causes and prevention of malaria, yellow fever, elephantiasis, plague, distemper, and the abolition of epidemics generally. The work of Major Ronald Ross and others not less devoted to the study has completely disposed of the old theory that malaria was due to miasmatic vapors, and it is now proved, by the use of the microscope, beyond a doubt, that it is due to minute amœbulæ in the human blood, which pass part of their lives in certain species of mosquitoes, and by means of mosquito bites infect man. The recent expeditions to Sierra Leone, largely defrayed by private generosity, have already succeeded in making the species of Culex, to which suspicion mostly points, comparatively rare in the neighborhood of Freetown, and in consequence a great reduction in the number of cases of malaria. Yellow fever and elephantiasis have also been traced apparently to gnats. The dissemination of bubonic plague is attributed to the fleas borne by rats. It is sad to have to record the death from yellow fever of one investigator, Dr. Walter Meyers, who went out in connection with the Liverpool School of Tropical Medicine.

Death has also taken from us Mr. George Shadbolt, of the Royal Microscopical Society, who did much for the development of the microscope, but whose name is perhaps best known as the inventor of "Shadbolt's turntable." In the theory of the microscope the most interesting contribution has been Mr. J. W. Gordon's criticism of Professor Abbe's diffraction theory, wherein he maintains that the diffraction effects relied upon by Professor Abbe in support of his argument are really produced by the diaphragms behind the objectives.

We must not omit also two more of Mr. E. M. Nelson's valuable papers on the construction of the microscope, dealing respectively with tube-length and working aperture. Amongst new books may be specifically mentioned Miall and Hammond's "Structure and Life-History of the Harlequin Fly," and "Carpenter on the Microscope."

In new apparatus notice may be taken of the increased attention paid by the opticians to the improvement of microtomes, and to the surrender by some of our leading opticians to popular prejudice, as evidenced by the demand for the Continental model in students' microscopes; also to the improvement in the spherical corrections of achromatic objectives by the use of newer glasses and original forms of construction. *Science Gossip.*

Notes on Microscopy.

M. I. CROSS.

RETROSPECTIVE.—The year 1901 did not witness any startling development in connection with the microscope, but it was one in which a very steady progress was shown in nearly every department. It witnessed the introduction of several new stands, principally for students' use, two-speed fine adjustment devices, the increase in number and variety, and, above all, in the aplanatism of substage condensers and the substitution of actual working data for apprcximation in the case of tube lengths and cones of illumination. In processes there were many new formulæ recorded, and judging from the number of articles which appeared on the subject, the science of micro-metallurgy is rapidly advancing. In the domain of preventive medicine, the best points of the microscope are becoming more fully appreciated and worked to greater advantage,and results are becoming increasingly reliable. In literature the fresh edition of Carpenter on the Microscope was a feature of importance, and the paper read by Mr. J. W. Gordon before the Royal Microscopical Society in controversion of the Abbe theory of microscopic vision is still fresh in the memory. On the whole, microscopists can congratulate themselves on the work done in the past year.

CO-OPERATION.—So much of the progress in microscopy in recent years has been attributable to the work of a few individuals that it has almost been lost sight of that the rank and file can and should do their share. It is eminently desirable that a column of this kind should be made the medium for conveying the thought, research and obstruction of microscopists generally. The subject is so many-sided that it is impossible for any one individual to present it in its various aspects, and it is for those who catch glimpses and side lights that others do not notice, to add interest and increase knowledge by communicating their observations. There is scarcely a microscopist possessing enthusiasm, or who works thoughtfully, who has not found some little device of his own designing useful to him, or some process which has enabled him to produce more satisfactory results than by stereotyped means. Readers of these notes would always appreciate a short description of such methods, and by the communication of such ideas increased perfection would be attained.

PRACTICAL.—If microscopists generally can but be induced to become practical workers, that is, to prepare and mount their own slides, an increased interest and wider knowledge would be the result. The difficulty invaribly is that suitable material cannot be procured; as an instance of this, I may mention that in the April number I offered to send a correspondent a small supply of Polcystina, and later mentioned that a supply was at the disposal of others. The applications that I received for samples indicated that there are numerous readers willing and anxious to mount their own specimens. Yet another instance; I have a letter from a correspondent, from which the following is an extract:—

"I hoped during the past summer to have been able to collect some specimens of Mycetozoa, but have not found one. What I want to suggest is that those collectors of such fungi who live in districts where they are found abundantly, should distribute their findings to those who are not so fortunate, by way of exchange, or for my own part I would willingly reimburse any expense in sending, as I should much value even a small collection. There must be many who have neither time nor opportunity of collecting who would gladly avail themselves of such an arrangement."—*Knowledge.*

A New Freezing Apparatus for Microtomes.

Our readers will remember a carbonic-acid refrigerating apparatus for microtomes which we described in our last issue. An ether apparatus for the same purpose, used by Dr. Albert Noll, of Jena, consists in evaporating ether in a vacuum in order to produce the necessary cold for freezing through the desired objects.

The apparatus is constructed as follows: A brass chamber, on whose upper surface lies the object that is to be cut, serves for the reception of the ether. This, Dr. Noll has used for some time on a Schanze microtome. The bottom of this chamber is 4 to 2·6cm. thick, the top 2·5 to 2cm. The height is 3cm. A shaft serves to fasten it to the microtome. On two adjoining sides of the chamber there are two tubes. The apparatus is connected by pipes. The first pipe leads to a gas funnel, with stop-cock, and through this the ether is filled. The second leads to an exhaust apparatus, preferably a water-suction pump, which clears the chamber and provokes the evaporation of the ether. The latter must be of thick material; the other should be of thin material. Having fastened the chamber of the microtome and attached the pipe, the funnel is filled; its tap is then shut with a certain quantity of ether. The funnel is then raised above the level of the chamber, the funnel tap opened, and the ether allowed to flow into it. The tap is shut, the funnel laid aside, and the exhaust apparatus set in motion by opening the water-cock. As a consequence, a vacuum is created up to the funnel tap and the ether evaporates. After about a minute there is sufficient cold developed to freeze an object lying in the chamber. With the dimensions of the chamber as given, and the full quantity of ether, the frost will last fifteen minutes. If it is desired to stop the operation in order to begin cutting, or to fill in fresh ether, open the funnel-tap and shut the water-cock.

The advantages of the apparatus appear to be in its unfailing action. There are no small bores present, and only a small quantity of ether is required, and the worker, as against the use of the ether-spraying apparatus, runs no personal risk. Further, once the apparatus is in work it requires no attention, and one can leave the machine to itself, in which respect it is not inferior to the carbonic-acid apparatus.—*Ice and Cold Storage.*

Notes on Microscopy.

F. SHILLINGTON SCALES, F. R. M. S.

C. BAKER'S NEW CATALOGUE.—Mr. Charles Baker has sent us his latest catalogue, which is an enlargement and revision of the previous issue. The arrangement of the contents might with advantage be copied by other makers. The first division contains particulars of microscopes, illuminating apparatus, mechanical accessories, and apparatus, for recording observations, all in due order. The succeeding divisions are devoted to apparatus for collecting, preparing, mounting, and storing specimens; to apparatus for bacteriology, blood examinations, and medical analysis; and to lists of microscopic slides, models, and specimens. Notable features are the explanations and exceptional detail as to measurements in regard to each entry in the catalogue. The very full list of objectives includes those of Leitz, Reichert, and Zeiss, as well as Mr. Baker's own series, and is very convenient for reference. We observe, however, some errors in the calculation of total magnifications with eyepieces of stated powers with a tube-length of 160 mm. The well arranged list of stains, mainly from the laboratory of Dr. G. Grubler, of Leipzig, will be of service to all microscopists, the list of mounting sundries being equally complete. The pages devoted to mounted objects are considerably extended, especially as regards the slide-lending department and we note that the prices of individual slides have been largely revised.

Preparing Insect Eggs.—As there has been no reply to my queries (Mounting Methods, ante, p. 154) as to devitalizing, preparing, and mounting insect eggs, it would appear to be a department of microscopical work in which much has not been done, and, as a small contribution to micro-technique, it is only fair that I should relate my own recent experience. At the time of writing I had a Vapourer moth, fresh from the chrysalis, which was ovipositing unimpregnated eggs in the pill-box in which it was brought to me. On the death of the moth I removed about half the eggs still attached to the white surface paper of the box. These were easily removed by a thin knife-blade. Being still firmly attached to the paper and to each other, they were easily divided into two smaller masses. One group I dropped into methylated spirit and the other into turpentine. I allowed them to macerate for a fortnight, when I removed them, still firmly fixed to the paper and to each other. They were then placed in a glass-topped box for another fortnight, so that they might thoroughly dry. The question was whether they would retain their plump, natural appearance, and whether they would be affected by the soaking, or would shrivel or collapse in the drying process. At the end of the first week it looked as though both batches would turn out right. At the end of the second week those in the turpentine remained absolutely unaltered, fresh, plump, and fully distended, but the spirit-soaked batch had nearly every egg more or less shriveled, with the upper face depressed or pulled down, as it were, with the periphery more or less flattened and the two sides drawn together. The turpentine group I put into a cell on crimson paper with a removable cover, and at this moment of writing, three months after the eggs were deposited by the moth, they look as though quite recently laid, making a beautiful top-light object for the 2-inch binocular. The untouched batch I have still in the original pill-box. They appear to be absolutely unaltered, and apparently as fit to mount as the group which I have mounted. We must not lose sight of the fact that the ova I write of were unfertilized, a fact that would of course, to some extent, bear on their subsequent conduct. Any information hereon from the experience of others would be useful to myself and to other readers.—*F. R. Brokenshire*, *Exeter*.

MICROSCOPICAL SOCIETIES.

ROYAL M. SOCIETY.—Nov. 20, four microscopes of great interest were presented to the society. Descriptions of three of these, prepared by Mr. Nelson, were read. Regarding one made by Powell and Lealand in 1848, Mr. Nelson writes:—This form was the first instance in which the microscope was hung in a tripod, and it was also the first where the fine adjustment moved a nose-piece by means of a lever inside a bar movement, and this specimen must have been about the last microscope made with the fine adjustment screw at the side of the bar, for it was in this year, 1848, that the screw was placed vertically above the lever, where it has remained ever since. Other features were referred to, and Mr. Nelson characterized it as historically an important and not very common form of Powell and Lealand's microscope. The next microscope described was an old one made by Hugh Powell, certainly before 1841, as in that year Mr. Lealand joined the firm, and his name would have been coupled with that of Powell, and the presence of a substage condenser prevents it being dated earlier than 1839. An important feature is the stage, which has an arrangement for focussing by means of three wedges moved by a micrometer screw. The stage has also a transverse micrometer movement for the measurement of objects. The third microscope was made by John Cuff. The date of its introduction was 1744, and it was called "A New Constructed Double Microscope." After the John Marshall microscope this is historically one of the most important instruments in the Society's collection. The other microscope presented was made by Plossl and Cie, Wien.

Messrs. R. and J. Beck exhibited a new pattern microscope embodying several new features. The substage was fitted with coarse and fine adjustments, and means of throwing out the condenser while it was in focus. The stage, 5 in. diam., was rotating and graduated on the periphery, with a removable mechanical stage graduated as a finder. The body was very short, fitted with double-draw tube, which allowed the body to be extended to 11½in. The body was fitted with Ashes' new double-fine adjustment.

Mr. Conrad Beck gave an exhibition of Anti-points, and said they were extremely difficult to show on account of the trouble there was in obtaining a light sufficiently smart and bright, and it was only possible to obtain faint images with so much diffused light as there was in that room. There was six microscopes, and all having ½in. objectives, and the points of light in the first two cases were produced by minute apertures in tinfoil; in the others the light was reflected from small mercury globules. With the first microscope a point of light was visible with a ½in. objective of ordinary aperture, and shows a point of light surrounded with faint diffraction circles. With the second microscope a similar point of light was viewed with a ½in. objective of very small aperture, and showed a disc of light and diffraction rings. The other microscopes showed the effects produced by placing various stops behind the objective, and also by viewing the point of light through a grating which extended the whole aperture of the objective. Mr. J. W. Gordon said he had listened with great interest to Mr. Beck's explanation of the demonstration, and was anxious to see the examples, and no doubt the experiment would demonstrate the existence and appearance of the antipoint in each case; but there was another and equally important image which he would like to see, and that was the antipoint which was formed in the eye, and he hoped some day Mr. Beck would be able to give a demonstration of this.

A paper "On Stereomicrography," by Prof. G. P. Girdwood, of McGill College, Montreal, was read by the secretary. Prof. Girdwood's method of obtainining steromicrophotographs was by placing the slide or object in a tilting frame attached to the stage of the microscope. The frame with the object was tilted to one side to the proper angle, and a photograph was taken; the frame was then tilted to an equal amount in the opposite direction, and another photograph was taken. Prints from the negatives were then mounted in the usual way, to form stereoscopic pictures. The paper was illustrated by a diagram on the blackboard, and a specimen of the stereoscopic photographs, placed in a stereoscope, was passed round the room.

MANCHESTER MICROSCOPICAL SOCIETY.—At the monthly meeting of this Society held at the Grand Hotel, Manchester, on December 5th, Prof. Sydney J. Hickson, M. A., D. Sc., F. R. S., delivered his Presidential Address on the subject of Fertilization. He said that modern researches have cleared away a great many false hypotheses as to the nature of fertilization, and had thrown much light on the biological meaning of the process. The study of the Protozoa had conclusively proved that the germinal cells were originally equal in bulk as well as being equivalent in function. The differentiation into ova and spermatozoa is characteristic of the Metazoa, as is accounted for by the necessity of the young embryo to have a sufficient supply of food material. After a discussion on the fusion of all parts of the germinal cells in fertilization, the President proceeded to describe the recent experiments on artificial parthenogenesis, and pointed out the bearing of these facts on the theories of fertilization. The address was illustrated by means of the oxy-hydrogen lantern, many interesting photo-micrographs of the actual fertilization of the ovum by the spermatozoa being shown.

SUNDERLAND MICROSCOPICAL SOCIETY.—The annual meeting of this society was held on November 19th. The annual report was read and officers elected, after which Professor G. S. Brady, LL. D., F. R. S., President, gave an address on "Problems of Pond Life," in which he alluded to the popular delusion that the microscopist who studied pond life was only truly happy when he found a foul, festering pool, covered with green slime and giving off poisonous gases. What the microscopist really sought for was a pond with clear water and abundant vegetation. One of the most interesting problems was as to where all the animals in ponds get their sustenance. After considering this question from various points of view Professor Brady said he had arrived at the conclusion that the lower forms of minute animal life had the faculty of extracting sustenance from the air and water, in a similar way to plants. Professor Brady also gave his experiences in connection with a dredging expedition which he joined really to settle this problem, and for which a special grant had been made by the Royal Society. They found that microscopic vegetable life did not exist beyond about fifteen fathoms from the shore, but they found myriads of minute animal organisms, millions of them in a thimbleful of water. Though really animals, they probably lived in vegetable fashion, absorbing their nutriment from the water in which they lived.

MICROSCOPICAL NOTES.

MICROSCOPICAL CEMENTS FOR FLUID CELLS.—Mr C. F. Rousselet, has advocated for closing fluid mounts the use first of a coat of a mixture of damar and gold size, then four thin coats of pure gold size, followed by a finishing coat of Ward's brown cement at intervals of twenty-four hours. Further experience has shown that the addition of this last coat is a mistake, as by excluding the air, it prevents the oxidation, and consequently the hardening, of the gold size. The gold size therefore remains in a more or less semi-fluid state under the brown cement, which is not good. Pure shellac is not soluble in 2½-per-cent formalin, and he therefore now closes fluid mounts as above, but with two coats of shellac between the damar and gold size, omitting the brown cement altogether, and hopes this will prove satisfactory.

DIATOMS IN RHODE ISLAND.—In the Report of Inland Fisheries of this state is a list of the diatoms found in the waters over the clam, mussel and oyster beds at Wickford prepared by Henry W. Lothrop and Norman N. Mason. The food of these shell-fish is composed very largely of diatoms and localities rich in such forms of life usually abound in diatoms. For this reason state commissions have learned to regard the adaptability of waters to oyster propagation before going to the expense of planting them. Of the various families of didiatoms there were found 14 species of Cymbellea; 78 Naviculea; 2 Gomphonemea; 2 Achnanthea; 11 Cocconidea; 35 Fragillaria; 12 Tabellaria; 33 Surirella; 17 Chætocerea; 12 Melosirea; 11 Biddulphiea; 1 Eupodiscea; 2 Heliopeltea; 17 Coscinodiscea,—a total of 248 species. Copies can probably be obtained by Diatomists by addressing either of the authors at Providence, R. I.

THAT AWFUL DROP OF WATER.—Public prints fairly reek with the utterly false statement which we now quote from "Spiritual Consciousness" by F. H. Sprague, page 61: "The microscope reveals a world of life in every drop of water." Microscopists are forever correcting this error but it still thrives. Will every subscriber please send us the name of the publication, name of writer and exact citation of where he sees this hydrahead pop up. We hope to be able to publish a long list of names of writers who have thus exhibited their ignorance. The clergy will be caught oftener than any other class of people.

HISTOLOGY.—We learn from London exchanges that a book on "Practical Histology" by J. N. Langley has just appeared, which is designed as a low price hand-book for students. Microscopical work and subjects are explained and 28 chapters describe experiments to be gone over. On receipt of a copy from the publisher we will give it further notice.

PHOTO-MICROGRAPHIC.—Do not fail to use color sensitive plates. There are several makes in the market.

Subscriptions for 1902

The published price of this Journal for 1902 will be $1.20. From this, a discount of twenty cents will be made for prepayment coming from the subscriber direct or through any agent or intermediary the subscriber may select. Whenever we have to send bills we shall charge the published price $1.20. We prefer not to deal through middlemen and therefore cannot hereafter, as many periodicals do, make a larger price in order that middlemen may get their allowances. We wish to net a dollar in advance without discount or trouble of sending bills and cannot put a premium on round-about methods which benefit neither the subscriber or the publisher. Yet as "agents" will be used and if used ought to be remunerated we publish the price at $1.20 and so authorize them to charge that price. Out of it they must remit to us one dollar.

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Micro-Photographs With an Ordinary Camera.

BY W. FORGAN.

So far as is known, no description seems to have been published of any apparatus used for producing micro-photographs, except that used during the Franco-Prussian War, for copying on a very small scale newspapers and documents to be sent outside Paris by pigeons. It was an elaborate and excellent instrument for the purpose. The object now is to show how anyone in the possession of a camera may produce micro-photographs by means of a very simple accessory. Probably very few are interested now in looking at these small pictures; and there are still fewer, it is believed, who know how to make them. When collodion was introduced by Mr. Scott Archer as the medium for more rapid photography, some time in the fifth decade of last century, it became possible both to make very small copies of large objects, and to produce enlarged copies of small ones. It was at first proposed to distinguish these two different forms by the terms "alphagraph" and "omegraph"; but the late Mr. George Shadbolt, while editor of the *British Journal of Photography*, suggested the terms "micro-photograph" and "photo-micrograph," and these latter terms have been universally used to distinguish the two forms from each other ever since—the term micro-photograph being invariably applied to small photographs of large objects, while the term photo-micrograph is used to signify a large copy from a small one. Notwithstanding this general consensus of opinion, however, it is found almost daily that the two terms are used indiscriminately to signify an enlarged copy from a small object. Medical men seem to be peculiarly prone to get confused by the two terms.

The camera to be used for the production of micro-photographs should be one with a rigid front, or capable of being rigidly fixed in that position, while that portion carrying the dark slide should also be capable of being rigidly fixed in the position it is to occupy while the photograph is being taken. The old form of box-camera would seem to be the very best form for this purpose. The flange in the camera front, used along with the accessory referred to, was that taking the Ross portable symmetrical and other lenses having the same size of screw. Into this flange there was screwed a thick drawn tube, such as is used for telescope eye-tubes, the tube being as the aperture in the flange would admit of. A ring was soldered on the outside of this tube, which was screwed to take the screw in the flange. The tube entered inside the flange about two inches, and was sprung at the end inside with cuts resembling the letter T placed horizontally. The other end of this tube or jacket was cut with an inside screw of 50 threads to the inch. Another piece of telescope draw-tube was selected about 6 in. long, which was made to slide easily in this jacket by grinding the two together with rotten-stone and oil. A ring about a quarter of an inch broad was soldered outside within an inch from the other end of this last-mentioned tube, and this ring was also cut with a screw of 50 threads to the inch, so that when this tube was placed inside the jacket and turned round, it could be made to approach or recede from the sensitive plate in the dark slide by a very minute quantity. To enable this to be done easily, this tube had a ring soldered on to its extreme outer end, fully a ½in. larger in diameter than the tube. This ring was knurled on the edge, which enabled the fingers to grip it without slipping, while the inner end of the jacket, being sprung, enabled the tube to be rotated by means of the fine screw motion without the least apparent movement of the image on the screen while focussing. The inner end of the inside tube had the universal microscope screw to take the object-glasses to be used. Both of the two latter mentioned screws should be carefully and evenly cut, no drunken threads being permissible. Of course, the tube was blackened inside, and a stop placed to prevent reflection of light from the sides. This accessory is really a very simple piece of apparatus, and easily made. The dark slide used was a single one. A carrier was made to fit it, having an aperture in the centre to take plates the size of a quarter-plate cut into twelve pieces. One of these plates was taken and obscured by grinding one side all over with fine emery. This was used for rough focussing, while another was taken and obscured by grinding the outside portions of one of the faces, leaving about a ½ in. square in the centre untouched. This was coated with a very thin film of virgin wax, and was used for fine focussing. This wax film makes probably the best screen for fine focussing. The glass is rubbed over three or four times with a corner of the wax, gently heated over a lamp, and then spread with the point of the fore-finger. Due care is taken to see that the small picture is in the centre of the focussing screen, and that no adjustment of collimation is necessary.

The negatives to be copied were quarter-plates illuminated by a 4in. condenser placed immediately behind them, and in almost close contact with them, their distance from the camera being regulated by the size of the micro-photograph desired with each object-glass used. It was found that with artificial light no other method of illumination would suffice to give an evenly lighted copy. The objectives used were Zeiss 75 mm. and 35 mm. apochromatics. The lamp used was an ordinary paraffin lamp with a ½in. wick placed in the focus of the condenser, and with such a light it was found that with Ilford ordinary plates, and the negative nearly 3ft. away, using these objectives, an almost instantaneous exposure sufficed. Everything being ready, the picture is roughly focussed by the movement of the camera itself, while the fine focussing is done by the rotation of the tube in the jacket by means of the fine screw. A focussing glass having considerable magnifying power is necessary, owing to the smallness of the picture. The camera may, of course, be so made as to take any size of plate, but it was found that those used were perhaps the most convenient of all, and although not transparency plates, good results were obtained. It will be seen from the above that no focussing screen on a separate frame was used, the focussing glass being carried in the dark slide itself, and removed each time the sensitive plate was put in, thus preserving the perfect register obtained. Probably those who make it their business to do this kind of work may have very perfect and expensive and rigid forms of apparatus; but the above accessory, when used with a somewhat rigid form of camera, does give good results.—*English Mechanic.*

Professor Howard on Mosquitoes.

Mosquitoes: how they live; how they carry disease; how they are classified; how they may be destroyed. By L. O. Howard, Ph. D., Department of Agriculture. 241 pp. 50 figures. $1.50, Mc Clure, Phillips & Co. New York.

Incidentally he tells how to collect and preserve these small scavingers. The adults are very fragile. The scales easily rub off from their bodies and legs. The antennæ break. As these parts are used in identification of the 50 or more species on record they are not handled with the fingers. They are caught by placing an inverted vial over them while at rest. Then plug with absorbent cotton saturated with chloroform.

With a ½ in. achromatic triplet lens, all the specific characters can be made out including the teeth of the tarsal claws if one is skilled. Otherwise, one may break off the tarsus and mount it upon a slide in glycerine or Canada balsam for examination under higher power. Howard says: "It is not advisable to mount adult mosquitoes bodily on slides in any medium whatever. They should not be preserved in alcohol or formalin but should be kept dry in vials." They are to be moved or mailed in pill boxes padded with cotton. Dr. Howard, being an entomologist, arranges his specimens for museum purposes by the triangular tag method, which he describes fully.

Dr. Howard considers the relation of malaria to mosquitoes. He regards malaria forms as protozoan (animal), not bacterial (plant-life). These protozoa go through a stage in the human red blood-corpuscles, feeding upon the red pigment and producing spores which later are liberated and this marks the beginning of malarial prostration. Another stage must occur anywhere outside of the human body and the stomach of mosquitoes (certain ones at least) offers the necessary habitat. Here appear the zygotes and centromeres and what under very high powers are shown to be spindle-shaped cells, known as blasts. The blasts multiply and are liberated into the body cavity of the host. Thence they get into the saliva and proboscis of mosquitoes from whence they are planted in human tissues provided the mosquitoes can get a chance to "bite" (sting) a victim.

Luckily, they require the cool or dark hours for their operations, so that Doctors Sambon and Low passed weeks in the Roman Campagna free from malaria simply by keeping out of reach of mosquitoes after 6 o'clock p. m. This occurred near Ostia in one of the worst parts of the Campagna. In numerous places, including our own states, malaria has been exterminated by secluding patients from mosquitoes and destroying their breeding places. Physicians and Boards of Health need to weigh carefully all the facts adduced in this volume. A war of extermination of the mosquitoes is now at hand to be participated in by all hotel keepers and property owners. The author gives ample directions for so-doing. The breeding places are described and also the means of extermination.

Among natural enemies of mosquitoes are fishes, especially the stickleback, top-minnow and sunfish. Predatory insects such as the dragon-fly are useful, as are night-hawks, bats and whippoorwills. Kerosine oil is most used to destroy larvæ and the cheapest petroleum answers every purpose. Permanganate of potash is not effective. Filling and drainage are proved to be essential adjuncts.

Not a more useful book has emanated from the workers in the Department of Agriculture than this one. Its mechanical features are all that could be desired. Its 50 engravings are first class. The facts are clearly and accurately stated. The author is one of those "good fellows" whose presence always brings cheer. No one would do you a good turn so quickly, so unostentatiously and so unselfishly. The book is characteristic of the man. Its knowledge will enable one to diminish suffering, improve real-estate, lessen doctor's bills, and increase happiness.

May we be pardoned one criticism for future use? The text is gotten up in the style of Governmental Reports. Every page is cumbered with citations and acknowledgements to periodicals, writers, officials, etc. A "Report" must be. A commercially published book should not be. All these authorities should be lumped in an appendix with reference numbers in the text. The reader don't care how Dr. Howard knows this or that. It trusts him as an authority and wants his conclusions in a compact space. The conscientiousness with which Dr. Howard credits a thousand observers in an official report, need not be carried into a scholarly treatise for popular use. To do so mars its interest.

Sectioning Stems and Leaves of Mosses.

A handy method of sectioning stems and leaves of mosses is a desideratum with most working bryologists. The one about to be described will be found, with patience and practice, to answer the purpose quite well in most cases.

Take a strip of heavy writing paper, say ¾ of an inch wide and 1½ inches long; on the middle of this spread a drop of glycerine so as to cover a space about ½ an inch long and ¼ of an inch wide; put the part to be sectioned on this space, the end to the right; place the paper on the stage of a dissecting microscope and clamp it fast; with a pair of curved forceps in the left hand to steady the part, and with a sharp scalpel in the right, commence the cutting, watching the process through the lens; when a sufficient number of sections have been made scrape them with the dull blade of a pen-knife to a dry part of the paper; if carefully done the sections will adhere to the blade, and may be easily transferred to a slide on which a drop of water has been placed; pick out the coarser sections, cover with a glass cover, and the remainder are ready for the compound microscope.

It is important not to have too much glycerine and to spread it evenly; a knife blade answers the purpose. The scalpel should have a keen edge; a knife will do if sharp enough. The parts to be sectioned should be soaked in warm water for two hours at least and longer if possible.—*G. N. Best in The Bryologist.*

Tuberculous Pericarditis.

Staining.—Wechsberg gives two excellent staining methods which he used in the laboratory of Weigert and in that of Ehrlich. In his second method he succeeded with a general tissue stain, including cell nuclei and protoplasm, connective tissue and elastic fibres, without clouding the bacillus stain in the least. It must be remembered that Wechsberg worked with the very fresh comparatively delicate tissues of recently killed infected rabbits. For fixing and hardening, alcohol was generally employed, only the eyes were hardened for one or two days in 10 per cent of formalin. Some preparations were fixed in Flemming's solution and colored with safranin to make the proliferating nuclear appearances more distinct. The tissues were subsequently imbedded in the usual manner, partly in celloidin and partly in paraffin. The staining methods were as follows: (A.) 1. Section staining for one hour at 37° C. in the thermostat in carbol-fuchsin. 2. Differentiation in muriated 70 per cent alcohol (1 and 2 were bacilli stains). 3. Staining with Delafield and van Gieson hematoxylin in usual manner (van Gieson). 4. Absolute alcohol, xylol and balsam. In such sections the bacilli were dark red, the cell nuclei blue or blue-voilet, the cell protoplasm yellowish brown, the connective tissue pale red. (B.) 1. Staining of section for an hour at 37° in carbol-fuchsin. 2. Differentiation in muriated and 70 per cent alcohol (1 and 2 were bacilli stains). 3. Section staining for one hour in Weigert's solution for coloring elastic fibres. 4. Rinsing in 96 per cent alcohol (3 and 4 were elastic fibre stains). 5. After coloring in lithium carmine and washing with muriated alcohol (for contrasting coloration, nuclei and protoplasm coloring). 6. Absolute alcohol, xylol and balsam. In these preparations the bacilli were dark red with a tinge of violet; the elastic fibres were dark blue; the remaining tissus of the contrasting coloration were light red with more darkly stained nuclei. Care must be taken not to make the lithium carmine staining too intense; the red bacilli staining was always clearly recognizable against the voilet-tinted red ground-work. Hartog mentions the following process applied to a large tumor mass of tuberculous tissue from the human subject. A piece was hardened in 10 per cent formal, then placed in 96 per cent alcohol, and finally in absolute alcohol. The pieces were then put in alcohol-ether and imbedded in celloidin. Sections of 0.015 millimetre thickness were then stained after the van Gieson method. Finally colored with the Weigert stain for elastic fibres.—*Post-Graduate.*

A Book Under the Microscope.

To discover the operations of protective tariffs and how high prices are maintained, we invite a microscopic inspection of these facts as to a small book on microscopy recently published both in London and America.

This book was printed and retailed in London for about 60 cents, per copy. The postage is about five cents and there is no duty on single copies sent direct to purchasers. But to buy from him you must outwit the London publisher by getting some friend to secure and mail to you a copy. Send the London retail price to the London publisher and he will refuse to sell to an American though he will sell to Germans, Russians, and Turks. He refers you to his N. Y. friend whose American price is $1.25. But the latter edition was printed in England at the same time the English edition was printed and it doubtless was sent over in unbound sheets. On these there was a small duty, not a tenth part of the saving made thereby, for the publisher pays American labor nothing for typesetting or press-work on it. He pays a few cents per volume for binding and that is all American labor gets. Nevertheless, he asks $1.25 for a small book,—all he would ask if he had to set the type himself. He will defend this by citing the small sale of a technical book and his high rents and salaries.

Thus a book retailing freely in London for 60 cents cannot be bought by Americans for less than $1.25. There is a conspiracy between the London dealer and the American dealer, and yet were I in London, I could buy from the London dealer by the dozen at one third off of his retail price and sell to Americans at 60 cents each and still make a profit, providing I got my supply without letting it be known what I was to do with it. Such things must always follow from attempts to legislate people into paying high prices for everything they buy. Such is all tariff legislation.

Notes on Microscopy.

F. SHILLINGTON SCALES, F. R. M. S.

IMMERSION OIL IN COLLAPSIBLE TUBES.—A German writer alludes to the disadvantages attendant upon the use of the ordinary bottle for immersion oil, which it is impossible to keep clean, and which allows the oil to thicken, turn yellow, and become turbid through exposure to light and air, thus altering its refractive index. In consequence, he uses collapsible tubes which are used for holding moist water-color and oil paints. It is stated that this form of tube has been used to contain Canada balsam with satisfactory results, and the writer referred to, determined to try how such tubes would do for immersion oil, although he was warned that the metal might have some deleterious effect upon the optical properties of the oil. After a year's experience he is able to state that the tubes have proved to be quite free from the faults which characterize the bottles, and that the oil is as clear, colorless, and thin as when first made, and there is no indication of change in its refractive index. Which of our opticians will be the first to put immersion oil and Canada balsam in this form ?

ROYAL MICROSCOPICAL SOCIETY, December 18.—Messrs R & J. Beck exhibited a new micrometer microscope, the body of which was made to traverse across a long stage by means of a fine screw, the milled head of which was divided so as to indicate a movement of 1-100th millimetre. The body could also be placed in a horizontal position, when it could be used as a telescope to measure distant objects. Mr. F. W. Watson Baker exhibited a number of microscopic specimens illustrating the development and the structure of eyes. They were shown under twenty microscopes, and were the most perfect sections that could be obtained from the best preparers in this country and abroad. Mr. E. M. Nelson sent three notes, which in his absence were read by the Secretary. The first was a description of Holtzapffel's microscope. The date of it is 1830, and in it are found four original devices : (1) It possesses a clamp foot for clamping the instrument to the edge of a table, pre-dating a similar device of Varley's in 1831 ; (2) the back of the mirror is flat polished brass, so that monochromatic light may be reflected by it ; (3) the stage is focussed by an eccentric which differs from and pre-dates the somewhat analogous devices of Pacini and Plossl ; (4) the movement of the lens-holder is by means of a steel tape and pinion.

The second note was a description of the first English achromatic objective, made by W. Tulley. It was a triplet and was made at the suggestion of Dr. C. R. Goring, who paid $450 for it. The focus of the combination is 0·933 inch, initial magnifying power 10·72, N. A. ·259, and the O. I. the large amount of 24·2. Mr. Nelson then described the Chevalier-Euler achromatic objectives of 1823-'24 and 1824-'25. These were doublets, and in 1827 Mr. J. J. Lister put one of Chevalier's doublets as a front and a Tulley's triplet as a back lens. The focus of the combination was 0·52 inch: it was the finest microscopic objective that had up to the time been produced, and was, strictly speaking, the first really successful scientific microscopic objective. Lister's labors in perfecting objectives and the great use they had been to the leading opticians of the day were referred to.

The third note was on "A Useful Caliper Gauge." It can be purchased at any watchmaker's tool-shop for 75c. or $1 and is convenient for measuring the thickness of cover-glasses, and for low-power work the scale may be placed on the stage of a microscope and the constant of an eyepiece micrometer be found by comparison with the mm. divisions. The president gave an account of some investigations which he had made in reference to a disease that had caused great mischief in cherry orchards in Kent. About fifteen months ago, when his attention was first called to it, the disease was prevalent over a considerable area, a noticeable feature in connection with it being persistence in the autumn of the dead leaves on the branches, instead of their falling off, as they would have done if the trees were healthy. The leaves of affected trees were pervaded by the mycelium of a fungus which destroyed them, and as the food of the tree was prepared by the leaves the growth of the tree would in consequence be arrested. The results of experiments in the cultivation of the fungus showed it to be one which belonged to the genus Gnomonia. Many of the fungi in this class passed through various stages in their life history; for example, the mildew on wheat, which was first developed on the berberry and then spread to the wheat, appearing originally as rust, and afterwards as mildew, from the mycelium. The President referred to the absence in this country of any author competent to investigate cases such as this. On the Continent, however, the Governments had taken up the matter, and the experts who had examined into it had found that to check the spread of the disease it was necessary to collect all the dead leaves and burn them. The President had consequently urged upon the fruit-growers the necessity of following this recommendation, but had only been able to persuade two growers to do so. Both of these, however, had found it to be thoroughly effective. Professor A. W. Bennet in his remarks enlarged upon the absence in this country of investigations into such matters by State-paid establishments, and described what was being done in the United States, where every State had its own experiment station. The President announced that the next meeting would be the annual meeting, when the officers and council for the ensuing year would have to be elected, the nominations for which were then read.

QUEKETT MICROSCOPICAL CLUB.—December 20th, 1901, Mr. Angus exhibited and described the use of two simple apertometers. The first was an ordinary semicircular protractor held at the middle of its periphery vertical to the stage; at the centre point was fixed a perforated film, mounted on glass, parallel with the stage. Riders or pointers slid along the arc, indicating the angle. The hole in the film was focussed by the lens to be tested, and the back of the lens examined with a low power, as when the Abbe apertometer is employed. The sine of half the angle indicated would be the numerical aperture. This appliance was valueless for measuring immersion objectives, as it only measured 180° in air. The second apertometer was merely a mm. scale placed in the turn-out ring of the condenser. The condenser and an objective of known aperture were focussed on the same plane, and the N. A. value of a division in the mm. scale was found by an examination of the back lens of the objective. When any other objective was employed, the number of divisions visible at the back lens, multiplied by the determined value of one division, gave the aperture of the objective. Mr. Angus showed the value of such a quick method of measuring aperture by the ease with which the size of diaphragms and stops could be found; he also gave proportions of stops to apertures which furnished the best dark-ground effects. Stops were shown that were made of black paper gummed to glass disks, cut to fit the condenser turn-out ring. The club's best thanks were accorded to Mr. Angus for his explanations which, it was hoped, could be put into a form suitable for publication in the journal.

A sliding microtome by Reichert was exhibited by Mr. C. Lees Curties, and described by the Secretary. This machine was on the "Thoma" model, with mechanical adjustments to every part, even to the tilting of the knife. The micrometer screw was reversible, thus obviating tedious unwinding. The instrument was very moderate in price. Mr. D. J. Scourfield, F. R. M. S., read a Paper on "The Ephippia of the Lyceid Entromostraca." The author originally intended to wait for sufficient material for a more comprehensive paper, but in view of the wideness of the subject preferred to deal with a part which had been fairly well worked at. He described the principal features of the formation and casting of these particular ephippia; the curious membrane around the egg, the thickening of the posterior margins of the valves, the growth of the line of cells across the valve, where the separation eventually takes place, and other apparently constant accompaniments. The author then showed the great variations in the sizes and shapes of the parts of thevalves which were cast by different species, and stated his belief that such variations were of value in determining species. The real uses of the marginal thickenings of the valves and the membrane surrounding the egg were suggested. A paper, by Mr. E. M. Nelson, F. R. M. S., "On the Black and White Dot," was read by the Secretary. The author asked indulgence for what might appear a puerile subject, but claimed that a proper understanding of the formation of the diatomic images must be the prelude to the acceptance of any theory of microscopic vision. He then proceeded to criticise the papers read earlier in the year by Mr. Rheinberg and Mr. Stokes, rejecting the "special" theory of the formation of the "black dots" made out by the former, and, though agreeing with much that the latter had stated, putting forward evidence which he believed to be in opposition to some of Mr. Stokes's conclusions.

ABNORMAL SECONDARY THICKENING IN CLIMBING PLANTS. —In its summary of botany at the last meeting of the British Association, "Nature" mentions a paper by Miss A. M. Clark in which the author describes the process of formation of the abnormal secondary thickening in Kendrickia walkeri, a tropical epiphytic climbing shrub. The anatomy of the young stem is typical of the family Melastomaceae. At an early stage numerous small patches and several large wedge-shaped areas of thin-walled unlignified wood-parenchyma are cut off from the inner side of the completely circular cambium ring. Tylosis is of frequent occurrence, and the tylosed cells may develop into sclerotic cells inside the vessels and tracheids. At a later stage the unlignified wood-parenchyma cells, at the central margin of the wedge area, take upon themselves new growth accompanied by cell-division. The product of this new growth proceeds to split the axial woody ring into a number of portions, with subsequent destruction of the identity of the wood elements. Later, the quiescent cambium, lying between the original internal phloem and the axial woody ring, takes upon itself new growth, and proceeds to lay down xylem on the one side and phloem on the other.

THE ARRANGEMENT OF CILIA ON PARAMECIUM.—The same journal contains a note on staining the cilia of Paramecium, which, in common with many others of the Infusoria, are so fine and closely set as to make it difficult to determine their exact arrangement even by the most careful focussing. A drop of Loffler's alkaline methylene-blue is mixed with a drop of water, in which the animalcules are swimming on the slide, and the cover-glass placed in position. Intra vitam staining takes place in many of the individuals; but they soon die, and the cuticle separates more or less completely from the cytoplasm and forms a halo round the deeply stained body. The perforations in the cuticle are thus brought very distinctly into view and the plan of arrangement of the cilia revealed. The stain is prepared as follows: Add 30 c.c. of a concentrated alcoholic (95 per ct.) solution of methylene-blue to 100 c.c. of a ·0001 solution of caustic potash. The caustic potash solution may be prepared by adding 1 c.c. of a 1 per cent. solution of potash to 100 c.c. of distilled water.

NEW OBJECTIVES BY OTTO HIMMLER.—By the courtesy of Messrs. W. Watson & Sons, of High Holborn, London, we have recently had an opportunity of examining two objectives by a comparatively new maker, Mr. Otto Himmler, of 9 Brandenburgstrasse, Berlin, that deserve more than passing notice. They were styled semi-apochromats, which implies only, we presume, that in them the newer Jena glasses have been used. Their corrections were exceptionally good, and showed once more how near the best and newest achromatic lenses come to the more costly apochromats. These particular lenses were ⅛-inch and 1-12th inch oil immersions, with N. A. 1·3. Both were excellent, but the ⅛-inch was really one of the finest achromatic objectives we have seen, possessing brilliant definition, whilst the price was only $16. and $22. for the 1-12th inch.

Lamps.—Acetylene has not yet been adapted to micro-work but the Welsbach mantle and burner have.

BIOLOGICAL NOTES.

By L. H. Pammel.

Spermatogenesis and Fecundation of Zamia.—Dr. Herbert J. Webber who has for some years made a study of Spermatogenesis and fecundation of Zamia has published the most important monograph on the subject that has appeared in this country. The more important facts brought out in his investigations are that pollination is accompanied by the wind, the pollen coming near the micropyle of the ovary is carried down further by a mucilaginous material which is evidently extended, and later is drawn into the pollen chamber at the apex of the nucellus. The mature pollen grain has two small prothallial cells. The blepharoplast arise in the central cell being formed de novo in the cytoplasm. Small at first they gradually increase in size. Shortly after division they are 18-20 microns in diameter. The kinoplasmic filaments, at first very few, increase till they are very numerous. The most interesting fact brought out in his studies is that the daughter nuclei form the spermatid cells and later become metamorphosed into spermatazoids. "The entire spermatid cell is metamorphosed into a spermatazoid, there being no differentiation of spermatazoids inside of the mother cell." The mature spermatazoids are the largest known to occur in any plant or animal, being readily made out without magnification. "In fecundation the entire spermatazoid enters the egg cell swimming in between the ruptured neck cells." Only one spermatazoid is used in fecundation although two or three may enter the same egg. Fecundation consists of a fusion of two or more entire cells, cytoplasm with cytoplasm and nucleus with nucleus.

MICROSCOPICAL SOCIETIES.

Postal Microscopical Society.—The Annual Report for the season 1900–1901 records an improvement on the previous year, not only from the financial point of view but in other details. The number of boxes sent out has been considerably increased, and the Hon. Secretary has felt justified in purchasing a fresh stock of slides for use of the Society, in addition to those contributed by the members themselves. The rules of the society have been modified in some details. The membership shows a slight increase, but we hope to see this improved upon in the forthcoming year. There are few amateur microscopists who would not find membership in this Society both helpful and stimulating. They would have the opportunity of examining a large number of slides partly professional, but mostly mounted by workers in the same plane as themselves. The selected notes which appear each month in *Science-Gossip* will show of what nature are the remarks and explanations accompanying such slides, and the subscription is only $1.25 per annum, with an entrance fee of 60 cents. The Society needs money less than the help and interest of those who are themselves interested in microscopy, especially of those who are interested in research of any kind, however humble. The Hon. Secretary is Miss Florence Phillips, Hafod Euryn, Colwyn Bay, North Wales.

Quekett Microscopical Society.—Friday, January 17, Mr. W. Wesché read an interesting paper: "Modifications of the Legs in some Dipterous Flies." The various structural arrangements to serve the purpose of combs and brushes for clasping, mating, and so forth were described in a number of genera and species. Drawings were exhibited, and a number of specimens shown under microscopes kindly lent by Messrs. Baker, of Holborn. The use of many of the modifications is problematical or quite unknown, and the author emphasized the far greater utility of observations directed towards clearing up some of these and other points in bionomics over that of merely making a collection of specimens. A paper on Ecpolus papillosus, n.s.—an unrecorded Hydrachnid found in Britain, by Mr. C. D. Soar, was communicated by Mr. Scourfield. It appears that hitherto the genus has only been described from Madagascar. The specimen itself was exhibited by Mr. Taverner, in addition to drawings by the author.

MISCELLANEOUS.

Observing the Circulation of the Blood.—The classical method for observing the circulation of the blood in living animals stands at present where it stood thirty and odd years ago, confined to limited parts of certain organs in the frog and other batrachians, the wings of the bat, the transparent parts of embryos of mammals, &c. It is about 17 or 18 years since, for the first time, I had an opportunity of observing, under the microscope, the embryo of a small fish that swarms in the lake of Managua, in this country. This fish, about 6 to 7 centimeters long, 1 centimeter wide, and 5 to 6 millimeters thick, lays its eggs on weeds and roots of plants growing along the lake shores, towards the beginning of the dry season, from November to March. The eggs are spherical, nearly two millimeters in diameter, transparent, and of albuminous appearance, and are furhished with a few hairy appendices, by which they are fastened to the weeds or roots under water, clustered like grapes in bunches of many hundreds and many thousands, tied together. Being so numerous and laid in different days, embryos of different grades of development may be had for observing the circulation of the blood. The eye catches at a glance a beautiful sight of the whole circulatory system, and follows with delighted attention, the streams of blood starting from the heart, running in the arteries and veins, and returning to the heart, whose beatings are conspicuously seen. The elongated globules of the fish's blood are distinctly seen, forming inside the blood vessels something like a string of beans. *F. J. Medina, Corinto, Nicaragua, Central America.*

STEREO-MICRO-PHOTOGRAPHY.—More than forty years ago I made many experiments as to the best means of obtaining stereoscopic photographs of microscopic objects. Results with the use of binocular microscopes were unsatisfactory, as all adaptations of prisms prohibited the employment of the higher power objectives, because only half the diameter of the lenses could be used, and this objection exists in a greater degree with the Riddell binocular shown in the article (erroneously termed the Stevenson). I obtained the best results without any prisms whatever, and could employ the very highest powers by getting rid of such impediments. The method was very simple. A small segment of the circle from the object-glass was stopped off by a black card, and a photo taken of a diatom or other objects. Next another impression was obtained on a separate plate, with an opposite and similar segment of the circle of the field stopped off. The resulting pair of pictures to be viewed with a sterescope.

But as diatoms and Lepidoptera scales are very thin and mounted flat, it is desirable in order to get a raised effect to enhance or exaggerate the perspective; therefore, for each exposure the object may be set a little out of the centre away from the stop, and in addition slightly altering the illumination to get the best definition in both views. By these means the stereoscopic effect may be very much improved, and some remarkable results obtained in relation to the structure of insect scales and diatoms, which is still a question of uncertainty.—F. H. WENHAM, in *English Mechanic.*

PREPARING TISSUES FOR PHOTOMICROGRAPHY.—A good deal of care is required in staining tissues so as to differentiate between the various systems that occur in such a structure as a stem or root and in the choice of stains, so as to render the light coming through these parts sufficiently actinic for the photographic plate. Such stains as eosin are, of course, eminently suited for the demonstration of such structures as the sieve-plates of sieve-tubes, but it is doubtful if the red light that comes through is very powerful actinically; and in cases such as these it would perhaps be more satisfactory to rely upon drawings taken from actual observation than upon the photomicrograph. In the photography of most transverse sections of stems, roots, and many other botanical specimens we may use with advantage as our staining material either toluidin-blue, haematoxylin, or both, for tissues with them turn a beautifully actinic blue on treatment with tap-water (not distilled water, because it requires the minute degree of alkalinity that tap-water possesses). We have obtained very satisfactory results with this method. In regard to differential staining a combination of methyl-green and toluidin-blue, or separate staining with these two, would give good results, as the actinic power of the former is much less than that of the latter. Tissues stained with eosin or carmine will, of course, give a result; but it is difficult to obtain good definition, and the cell-walls, etc., only come out faintly, with somewhat blurred outlines. But a differential stain with eosin and toluidin-blue is quite satisfactory. The structures should be mounted so as to exclude all air-bubbles; a photomicrograph of delicate tissues in which a large bubble is incorporated is, as a rule, quite spoilt on account of the effects of reflection and refraction at the surfaces of the bubble. Styrax is a good mounting medium, Canada balsam being rather yellow even in thin films.—*H. A. Haig in Science Gossip.*

George Massee's View as to the Origin of Potato Tubers.—Until quite recently it was generally supposed that potato tubers were included in the general scheme of evolution that resulted in the production of the potato plant, their function being that of reproducing the species in a vegetative or asexual manner. In this supposition, from the point of view of Noel Bernard, we have been very much mistaken. According to him, the presence of tubers on a potato plant is quite accidental, and entirely depends on irritation of the tips of the subterranean branches occasioned by a minute fungus called Fusarium solani. This particular fungus is so abundant in the soil that it is practically impossible for potato stems to escape the necessary irritation, which results in a tuber. To prove this theory the author planted sterilized potato tubers in sterilized quartz sand. In some instances no tubers were formed; this proved the truth of the theory, so says M. Bernard. In other cases a few tubers were formed, but according to the author these were due to the fungus having gained access to the roots in the sand. Many people have planted potatoes under conditions much more favorable than that of sterilized quartz sand, and yet have failed to secure a crop. Fusarium solani is considered by vegetable pathologists as the fungus which causes one of the worst of diseases to which potatoes are subject.

The idea of the formation of swellings on the roots of plants, due to the irritation of fungi or bacteria, is not altogether new, and in some instances is quite true, as in the case of the swellings on the roots of leguminous plants, and the roots of the alder, etc.; but in these instances it is either a case of true parasitism, or of mutualism, where the plant benefits from a nutritive point of view. There is no clearly demonstrated case where vegetative reproductive bodies result from the action of an outside agent, fungus or otherwise.

For Sale.—A Beck stand with three lenses, very little used. Price $10. Address: G.W.Wilcox, care this office.

NEW PUBLICATIONS.

ANIMAL LIFE—is title of a new book by D. S. Jordan. An English notice calls it "superficial in character." Its classification of animals is "most certainly marred by all disregard for order and method in the arrangement of the examples selected to represent each class. Genera and species from numerous orders are jumbled hopelessly together in one chaotic muddle." We should be pleased to see this remarkable book and to try to find something to commend in it. We suppose this author is President of Leland Stanford University.

THE MICROSCOPY OF THE MORE COMMONLY OCCURRING STARCHES.—By Hugh Galt. 108 p. 22 photo micrographs.

A comparative study of the starch grains of various plants is a very interesting and profitable one to all microscopists, and a good working knowledge of the subject is absolutely indispensable to those who, in the capacity of analysts, etc., have occasionally to report upon various unknown compounds submitted to them for examination. There seems to be no book dealing with the starches in a thoroughly comprehensive way. The present book, supplemented by W. Griffiths's little treatise published in 1892 on "The Principal Starches used as Food," for the sake of its photographs, will probably be helpful to many who are in want of a concise account of the microscopic appearances of the commoner starches.

The essential portion of the book consists of a series of short chapters, each of which is devoted to a description of the shape, size, markings, behavior towards polarized light, etc., of a particular starch. Altogether the author treats of thirteen varieties—namely potato, rye, rice, oat, maize, pea, sago, tapioca, wheat, barley, Bermuda arrowroot, "tous-les-mois," and haricot bean starch. A synoptical table at the end of the book brings together the principal facts recorded in connection with each starch in a very useful way. One thing the author especially insists upon, and rightly so, namely, that the markings occurring on some starches are never so plain as they are shown in the figures in the text-books of botany, hygiene, etc. But on the other hand, we think he rather overstates the difficulty of seeing these lines. He says of potato starch, for instance, that "these lines are in all cases faint ; indeed, to see them at all it is often necessary to reduce the aperture of the diaphragm of the microscope very considerably, or to use oblique light. . . . The lines are apparent chiefly in the larger ellipsoidal grains, but not in all of these, the smaller grains only occasionally showing any trace of such lines." With specimens freshly scraped from a potato and immediately examined in water there should be no trouble, however, in seeing the concentric lines with a 1-6″ objective and a large axial cone of light from the condenser, and we have never yet under such conditions seen one of the larger grains without markings. Even the smaller grains, with the exception of the most minute, more often than not exhibit a few concentric lines. In dealing with wheat starch the author does not allude to the peculiar reticulated sculpturing of a part of the surface which a small percentage of the grains usually exhibit.—*Quekett Club.*

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Are Potatoes Fungi or Not?

BY ARTHUR M. EDWARDS, M. D.

There comes now a discovery which makes potatoes fungi and not the root of the plant upon which they grow, which is so extraordinary, and withal is made by a competent botanist, that it makes us pause. It seems that M. Noel Bernard a perfectly competent botanist has made this discovery and it seems so rational that we are bound to believe it. He notes that potatoes gathered for planting have a resting period of several months, after which the vegetation is resumed. Even when kept in cellars which are well-lighted and well-aired the part commonly and popularly known as "eyes" develops and from them stalks also appear. Cultivators are careful to allow this first developement to take place normally, for cultivation succeeds well when the sprouted eyes are planted. So that these eyes are cut out and used to plant the potato for the potatoes.

The plant does not run to seed and the 'seed' is planted to raise the plant which grows the things we call potatoes. And therefore the potato is said to be a swelling of the root. But we will see, as Mr. Bernard discovers, that the potato is not the root but an excrescence on the root,—in short a fungus. But to make this clear to those who are not versed in fungi we will have to go into the meaning of certain terms used.

First of all it must be understood that there is no distinct demarkation of fungi into vegetables and animals. The fungi constitute a class as it may be called separate, being neither animals nor vegetables. In fact, when we come to consider them, we must leave the old division of animal and vegetable out of the question. But what is called the vegetable body or thallus consists of a filiform, cellular element or elements which are known as hyphae. These are hair-like or perhaps like cotton. In one group, the Phycomycetes, the hypha consists of a single branching cell, so to speak; but in most cases it is composed of a series of these cells placed end to end. And this is all the fungus consists of,—essentially a small cell, so to call it, or a minute piece of hardened protoplasm. And when it proceeds to propagate or increase in number, it takes on a new form of life. It then has to disseminate to form, or to increase the species, as it is called. So that it makes new forms of life; it makes spores. But these are not essentials of the fungus itself as formed. It forms at first what are called chlamydospores, that is to say spores that are formed without the union of two individuals, male and female. These are formed on the hypha and commonly in the dark and immersed in the thing that the fungus lives on. It also forms spores, true spores that seem to be for the disseminating of the fungus.

For a period of thirty or forty days after planting, the stalks that spring from the eyes of the potato grow into the potato-plant, Solanum tuberosum, and put out leaves and flower buds, while other so-called buds in the lower part of the stalks push out underground stems. But these undergrown stems never develop potatoes unless a fungus or fusarium is present, and this fusarium is always present in the skin of what are known as potatoes. In May, the terminal buds of the stems cease to throw out sprouts. They become hypertrophied and form tubers in which the larger part of the nourishment sent to them is stored up. The aerial buds are now almost completely arrested in their growth. M. Henri Conpin who who records M. Bernard's discoveries in *La Nature* says: "We see that these two periods are characterized by two different modes of growth of the young buds. This must be attributed not to an alteration of condition in certain buds, but to a general modification of the state of the plant, of which the tuberculization of the terminal buds is the essential symptom."

The causes of these modifications may be ascertained by a microscopic study of the roots. We shall see that in the second period, these are surrounded by the filaments—mycelium of a fungus of the genus Fugarium. This is never absent. It also exists normally in the skin of the tubers, but not in the interior. This fusarium easily lives as a saprophyte in various culture mediums. For example, it impacts dung rapidly and throughout its whole mass. It may be noted that frequently in the cultivation of the potato, dung is utilized by placing it around each seed-potato. This method which is recommended by Parmentier, is evidently favorable to the propagation of the mycelium.

The roots of the potato are long and ramified and their development is very rapid; they grow in all directions away from the seed-tubercle; infection is consequently irregular. This proceedure explains the irregularity noticed by all cultivators in the formation of the new tubers. M. Bernard desires to find out whether by insulating an earlier and more regular infection of the roots, he would make the yield earlier and less variable. To this end he raised two lots of potatoes under the same conditions, except that to the one he added the fungus in abundance, while in the other he allowed the roots to be infected only by some filaments occurring at the surface of the tuber. In the former case he obtained a crop that was larger, earlier and more regular. There is thus plainly a relation between the production of the tubers and the infection of the roots.

These ideas explain several facts relative to the introduction of the potato into Europe—facts that have never been fully cleared up before. It must be noted that the fusarium exists on the tubers but not on the seeds. Now the introduction of the potato into Europe was by tubers; by their means it was cultivated from the outset, and it seems that the method of cultivation by seed was not thought of until the plant was so largely grown and so highly esteemed that the production of new varieties was sought. At the outset, then, this fungus must have been introduced and acclimated at the same time as the plant. The history of the first attempt at growth from seed is little known. Nevertheless there is in existence a document on the subject whose age gives it interest. Charles de l'Ecluse, who was probably the first to cultivate the potato in Germany, at the end of the sixteenth century, and who acted by making it known by distributing tubers and seeds, reports in his "Rariorum Plantarum Historia" (History of Rare Plants) that "we must rely for the conservation of the species on the tubers alone." The seeds that he sent to his friends sprouted perfectly, but the plants produced flowers and not tubers. E. Rose who cites this passage from l'Ecluse's work, notes properly that it is of great interest. Nowadays things occur differently. Those farmers who make the potato a special object of cultivation use the seed, but generally the plants obtained during the first year have no tubers and do not flower. A large number of the varieties that are now raised have originated from seed, and they, as well as the others are found to be infected with the fusarium. It was then, only after the fusarium was acclimated as well as the plant, that we could obtain from seed the result that we desired, and that the tuberculization appeared to be hereditary.

Now fusarium, according to Griffith and Henfrey in the Micrographic Dictionary, is a genus of fungi not very satisfactorily distinguished from fusisporium, and fusisporium grows upon vegetable substances, often when decaying having spindle shaped spores. There are several species of a rose color. At any rate this discovery of M. Bernard is important and seems to be genuine. The microscopic fungi are looking up.

Formaldehyd and Small-pox.

The medical profession has made a discovery,—that small-pox is a filth disease which yields readily to cleanliness and to disinfection. It has discovered that makers of vaccine are incompetent, if not careless, and that even good vaccine very easily deteriorates. Strangely coincident with these discoveries, a throng of "mental-healers" has flooded our papers with protests against vaccination. The latter know nothing of formaldehyd disinfection but unwittingly paved the way for its acceptance.

Speaking to doctors only, in the Medical Society of Cleveland, behind closed doors, Martin Friedrich, M. D., Health Officer, said that commercial bovine virus is dangerous, that it is too unreliable in cases of epidemic, that frequently it will not take, that popular feeling is seriously against it, that sepsis results and makes serious trouble. He told how he had to lie to patients as to "the ugly suppurating wounds" he had made. He said that such sepsis, with all its horrors, does not even protect from small-pox. He had "four fatal cases of tetanus develope after vaccination. It seemed to be a secondary infection but no one can doubt that there is some connection between tetanus and vaccination. Vaccination seems to prepare the soil for tetanus by causing suppuration." These are not the words of an anti-vaccination crank but of a Health Officer confronted with an epidemic of small-pox. Something had to be done. The anti-vaccination people do nothing. They simply lay around and howl.

In 1898, Cleveland had 48 cases; in 1889, it had 475; in 1900, it had 993 cases; and, in eight months of 1901, it had 1230 cases. The city was frightened! A new Health Officer was but four weeks on duty. Christian Science had increased in about the same ratio but affirmations and denials had no effect upon the spread of small-pox; neither did vaccination!

Dr. Friedrich, whose name ought to go down to posterity with that of Jenner, DROPPED VACCINE, but took up formaldehyd. He drilled a squad of 40 medical students and sent them into every house where small-pox had been or was even suspected. He paid particular attention to nooks and corners, closets of all kinds,—every place where exposed persons had been. Clothing, particularly winter-wear liable to contain germs, was disinfected. It must be remembered that to fill a house with this deadly gas, people are turned out of doors for from three to ten hours, and yet few if any rebelled. Along with this work, went the enforced cleansing of barns, stables, cellars, dumps, vacant lots, puddles and stagnant pools. Unpaved streets and unsewered places had to receive special attention. The city was induced to co-operate in all these ways and small-pox was annihilated in Cleveland inside of a few weeks without a single case of enforced vaccination. It is not to be supposed, however, that vaccination is a thing of the past. But vaccination with the usual commercial virus by old methods is a thing of the past so far as concerns the most intelligent physicians. Why should not the new discovery of the uses of formaldehyd replace to a large extent cruder means of dealing with small-pox epidemics even to replacing vaccination?

In the discussion over Dr. Friedrich's paper, Dr. Thomas related vaccinating 70 Asylum children with glycerinated vaccine and not a case took. A second lot of vaccine took, in every case, and there were no septic arms, or other troubles. This proves that vaccination skillfully attended to is not what pessimists have taught the public to believe. But a loud outcry ought to be raised against certain manufacturers, and doctors must not pay for goods until they have tested and proved them. All who are interested in this matter will do well to send 20 cents for the February number of the CLEVELAND MEDICAL JOURNAL which devotes 12 pages to a report of the subject.

BIOLOGICAL NOTES.

BY L. H. PAMMEL.

AGRICULTURAL BACTERIOLOGY.—A study of the relation of bacteria to agriculture with special reference to the bacteria in the soil, in water, in the dairy, in miscellaneous farm products and in plants and domestic animals. H. W. Conn, VI, 412 40 figs. P. Blakiston's Son & Co, Philadelphia, 1901, $2.50.

It is gratifying that an American author has published a work that will greatly aid in setting aside the erroneous impression among laity and physicians that the bacteria are all injurious. The author has treated in a comprehensive manner the use of bacteria in the arts and industries. Bacteria are important in many problems connected with the farm, such as dairying, the subject of nitrification, the appropriation of nitrogen by leguminous plants, the disposal of sewage and the problems connected with it, such fermentations as vinegar, sauerkraut, the curing of tobacco. The author has given up-to-date information on the chemical ferments or enzymes, so little understood. Excellent illustrations accompany the book and the lucid style makes it admirable for students.

SPORE FORMATION IN SACCHAROMYCES APICULATUS.—M. Seifert has given an interesting account of the organisms which produce alcoholic fermentation in grapes. Some experiments made with different forms of the species of Saccharomyces apiculatus produced fermentation of wine. The author found great differences in regard to the formation of spores. None of the forms produced spores at 39° C. The range was from 25° to 37° C.

In addition to the Saccharomyces apiculatus there are short accounts of Monilia candida. Some of the Mucors and Aspergilli are discussed. (Mitth. K. K. Chem. phys. Versuchst. fur Wein u. Obstbau Klosterneuburg).

PARASITICUM OF FUSARIUM GEMMIPERDA.—Aderhold who has conducted some experiments with the saprophytic Fusarium gemmiperda Ad. states that this fungus becomes parasitic under favorable temperature conditions. A cherry-tree on which the disease was abundant in 1898 and 1899 was entirely absent during the dry season of 1900 though abundantly sprayed with the fungus spores. The fungus affects the flower buds before they are open. The spores are at first one-celled, later become 3-5 or more celled. (Separate Zeitsch. f. Pflanzenk. 11: Heft 2 & 3).

PARASITIC HELMINTHESPORIA.—Kalpiu Ravn who has investigated the species of Helminthesporium producing disease of barley and oats concludes that the H. gramineum produces a disease in barley. H. teres occurs on barley and maize and H. avenae on oats. The intensity of the diseases produced by them is not alone caused by the fungus but in a great measure due to times of sowing, temperature, variety. The H. gramineum is distributed by the conidia which fall upon the grain and in this way reaches the field next season. The spores of H. teres are likewise spread with the grain. The cultivated mycelium of H. gramineum and H. teres was killed when heated at 55° C. for five minutes. In pure cultures conidia do not form readily. He has only observed them in H. teres on sterilized leaves of barley and of beer-wort. (Separate Zeitschr. f. Pflanzenk. 11: Heft 1).

DISSEMINATION OF JEFFERSONIA AND PALLINATION OF APIOS.—Hildebrand under the caption of Einige biologische Beobachtungen observes that the flowers of Jeffersonia diphylla are proterogynous, when the weather is unfavorable the flowers are cleistogamous. When the fruit is mature and the horizontal opening begins to form the capsule is erect, as the opening extends the capsule begins to bend at the base so that there appears a lid. When the capsule lies in a horizontal position the seeds fall from the upper portion of the placenta on the lower lip where they are easily carried by the wind. The capsule continues to bend from the horizontal position more and more downwards till it is entirely erect, and all seeds have dropped out. The fleshy arillus no doubt causes ants to carry the seed away. The seeds falling to the ground the end of July germinate in May, but sparingly, The cotyledons in germination remain in the testa.

In the case of Apios tuberosa the author suggests that the reason why so few seeds are set is due to the peculiar mechanism of the flower. The insect must reach to the bottom of the flower. The wings on the right and left of the keel are used by the insect as a support but they never free the reproductive organs. The plant largely propagates by the underground tubers. (Berichte d. deutsch. bot. Gesellsch. 19: 472, 479).

ANATOMICAL CHARACTERS FOR SOME GRAMINEAE.—Theo. Halm's anatomical studies of Gramineae and Cyperaceae are well known. His latest study: "Some new anatomical characters for certain Gramineae" is an excellent contribution considering as it does the anatomical character of a large number of genera and species. The author describes the interesting occurrence of a double parenchyma-sheath of Aristida fasciculata which occurs in some other species of the genus and not by any other genera examined. It no doubt constitutes a generic character. It is not due to environment and such species of the genus that do not possess this double sheath should be removed from the genus proper and especially so because their morphological characters are so distinct. Interesting are his observations that it does not seem as if any special type is characteristic either from the plains, the prairies or the fields. The Aristida fasciculata is thus associated with many and diverse types of Gramineae all of which have been classified as "Xerophytes." Yet there is a similarity of structure among all of the types studied from plains, fields and swamps. The author thinks it is a mistake to establish such societies as xerophilous, hydrophilous, etc., without having studied their structural peculiarities. The suggestions are certainly worth considering in studying the ecological relations of plants. (Separate Beiheft. Bot. Centralbl **11** : Heft 2. 1901).

Extracts from Postal Microscopical Society's Note-books.

Edited for Science Gossip.

SECTIONS OF STEMS.—These slides are intended as illustrations of the varieties that vegetable tissues take under the varying conditions of exposure to light, heat, and moisture, etc. Beginning with sections that illustrate the normal forms of the monocotyledon, the dicotyledon, etc., there follow modifications of these, some of which it would be difficult to assign to any of these groups did there not exist other means of classification than that of structural arrangement. These different slides commend themselves to observers, if for nothing else than for the elegance of form which they present.— *W. Pumphrey.*

A very important factor in the P. M. S. is to cater for the learners ; and however excellent may be the dealer's slides which are at times furnished by members, they do not advance the best interests of the P. M. S. as slides of less perfect finish do, whose bona-fide touches and descriptions are instinct with the spirit of helpfulness. Even quotations from books, such as Carpenter's, might form the groundwork of some interesting and practical communications. "Light, heat, moisture; etc.," in the formation of vegetable tissues, call up some of the most interesting problems connected with structural botany. For instance; what causes a double, or even a multiple, succession of rings to occupy the place of a single one, as ascertained by transverse sections of wood?—*J. Birkbeck.*

Slides should not be circulated merely as objects of beauty. They must convey instruction. We are never tired of having described to us the beautiful devices which Nature adopts to build up the various natural objects which surround us. There is, in truth, a very fine delight in the acquisition of scientific information new to ourselves, even if the information has been known for ages to others; and, further, those to whom these scientific facts may be well known never tire of having them brought fresh to their notice—especially if the old story be well told and illustrated.—*J. R. L. Dixon.*

ARISTOLOCHIA CLEMATITS.—Shows the concentric and regular disposition of the vascular bundles in dicotyledonous stems. It will be observed that the stem is a young one, as evidenced by the amount of pith, which in the root may be so much checked, as almost entirely to disappear.

RICINUS COMMUNIS.—Shows a hypocotyle of this dicotyledonous plant. The vascular bundles consist of phloem externally and xylem internally, separated by a layer of cambium which is continued into the fundamental tissue lying between the vascular bundles as interfascicular cambium. The xylem contains vessels with narrow pits and vessels with broad pits with wood parenchyma between them. The pith and primary cortex are also shown.

CYPERUS LONGUS.—Shows irregular disposition of vascular bundles in monocotyledonous stem. This arrangement of bundles is due to the obliquely radial course of the leaf-trace bundles. These enter the stem from the leaves, run obliquely downwards into the stem, and then bend again outwards and approach the surface. A transverse section may thus pass through different leaf-trace bundles at different heights in their course and show therefore bundles of different structure and size.—*J. R. L. Dixon.*

Notes on Microscopy.

F. SHILLINGTON SCALES, F. R. M. S.

WATSON'S NEW "UNIVERSAL" CONDENSER.—The faults of the ordinary Abbe condenser are, as is well known, the imperfection of its spherical and chromatic corrections. The former in particular greatly reduces the value of the condenser for the critical work. With a numerical aperture of from 1·2 to 1·4 the aplanatic aperture does not exceed ·65. There have been several achromatic condensers upon the market, but their aplanatic cones have but slightly exceeded the simpler Abbe form, whilst the mounting has been so cumbrous as to frequently interfere with the movements of the mechanical stage. Within the last year or two there have been put upon the market several condensers of large N. A. and almost equal aplanatic aperture, but their powers have been not less than ¼ inch, with a field accordingly too small to be advantageously used with low-power objectives. To Mr. Chas. Baker must be given the credit for first putting in the hands of microscopists a condenser with a N. A. of 1·0 and an aplanatic aperture exceeding ·9, and with a power of less than ⅓d inch. Messrs. Watson & Sons, of High Holborn, have just brought out a similar condenser, which they have submitted to us for examination. Its N.A. is 1, and its aplanatic aperture is not less than ·95, whilst if the exact thickness of slip for which it is corrected be used its total aperture is aplanatic. The power is 4-10th of an inch, and the mount is very compact. The corrections are excellent, and we can strongly recommend this condenser for almost all kinds of work and for photography in particular.

CHARLES BAKER'S DEMONSTRATIONS OF MICROSCOPIC MANIPULATIONS.—This new departure fully justifies itself and the attendance has steadily increased. Eleven demonstrations have been given up to the time of writing, and the total attendance has been 124, giving an average of eleven. Three persons attended the first demonstration, whilst eighteen attended the last—an increase which testifies to their value.—*Science Gossip.*

EDITORIAL.

KEY TO THE INFUSORIA.—We have received copy for a Key to the Infusoria which will cover about 25 pages of the Journal and be issued in our May number. Eight pages already in type, are held over in order that the Key may be published all together. This explains the Journal being a little smaller than usual this month.

THAT DROP.—"When, with your imperfect microscope you examine, for instance a drop of water, or simply air, what do you see? You notice millions of infusoria,—millions of atoms, do you not? Do you know what air and a drop of water are?" Thus writes Agnes E. Marsland in "Light on Occult Science," p. 22. She labels herself: "Graduate of the Univerity of Cambridge, England," but we do not believe that any Cambridge graduate could be so ignorant regarding infusoria.

DIAMETERS.—A new subscriber asks what part of an inch constitutes a diameter in microscopy. The word misleads and confuses him. A magnification of ten diameters is a picture whose diameter is ten times as great as that of the object magnified. Ratio only is expressed. So we cannot tell him the part of an inch unless we know the diameter of the object magnified. Buy Gage's book and it will explain a hundred such difficulties.

L. A. WILSON of Cleveland, Ohio, died Dec. 15, 1901. He had been a close student of the microscope for many years and a contributor of both money and articles to the Journal. He had a large collection of lichens and liver-mosses, classified and catalogued, which his widow would like to dispose of. If possible to do so she will sell them. If not, we suppose they may be donated to some public institution.

MICROSCOPICAL MANIPULATION.

PRESERVATION OF URINE.—According to Dr. Schweissinger, in the *Pharmaceutische Centralhalle*, thymol is the best agent for the preservation of urine for examination with the microscope. It prevents fermentation of all descriptions, and does not interfere in the re-action of the constituents. A granulet, the size of a pin's-head, will suffice to preserve a hundred cubic centimeters of urine for a long time.

DISEASE OF TURNIPS.—Turnips are subject to a parasite called Pseudomonas campestris which has been examined by E. F. Smith. He made a culture of this bacterium and innoculated the turnip leaves through needle pricks. After 52 days, the leaves were shrivelled. Sections of the root showed abundance of bacteria. No fungus or animal parasite was found, but cultures from the interior of the root yielded P. campestris. He fixed the root with strong alcohol, infiltrated with paraffin, cut with sharp knife, mounted with water, plus ½ per cent gelatin freshly prepared. He dissolved the paraffin with turpentine, stained with carbol-fuchsin, washed with alcohol, 50 per cent and move up to absolute, soaked in xylol and mounted in C. Balsam. The vessels and parenchyma alone were affected by P. campestris. The short bacterium infesting many bundles and cavities in the parenchyma were found. This method of fixing and handling allows a complete study of the organism. The knife does not displace or tear the material. All stages in the destruction of cell walls are exhibited, from single cells to large cavities filled with debris and P. campestris. It crowds the cells apart, breaks down the middle lamella and then gradually obliterates the cell walls.

LUSTRELESS BLACK VARNISH FOR OPTICAL INSTRUMENTS.—Rub fine lampblack with shellac varnish. If the surface of the varnish when dry shows any luster, it contains too much shellac and should be diluted with alcohol. It is said that this is a safer varnish to use in photographic dark slides than any kind containing turpentine.

CONVENTION.—The American Congress of Tuberculosis meets in New York, May 14, 15 and 16 at Hotel Majestic. An effort is being made to present a collection of objects including microscopical and biological in connection therewith. Slides can be sent to Dr. H. Edwin Lewis at Burlington, Vt. up to the week of the convention.

LIQUID GLUE.—In a solution of borax in water, soak a good quality of glue until it has thoroughly imbibed the liquid. Pour off the surplus solution and then put on the water bath and melt the glue. Let it cool down until the glue begins to set, then add, drop by drop, with agitation, enough acetic acid to check the tendency to solidification. If after becoming quite cold there is still a tendency to solidification, add a few drops more of the acid. The liquid should be of the consistency of ordinary mucilage at all times.

Vital Phenomena.—Houghton (Chicago) has created a protoplasmic cell which has many attributes of the ameba, and says: "I succeeded in producing an active protoplasmic mass with distinct nucleus-like centers, which showed ameboid movement. It assimilated nutriment, gave reaction to analine dyes which organic cells give, had a protoplasmic reticulum, showed selective affinity, and even made feeble attempts to perpetuate its species. It split into four or five cells which had the same qualities as the mother-cell. After activity of from ½ hour to three weeks, the cells lost their power and became inert. My cells fulfill all the conditions of living cells such as ameba, except as to the power of perpetuating the kind. I think we shall soon discover this."

NEW PUBLICATIONS.

Carotid Artery.—A full-page microphotograph of cross-section at the point of closing the cartoid artery is published in the Annals of Surgery for April. Dr. Geo. Crile of Cleveland made it in some experiments on the temporary closure of this artery.

Bone Cyst.—Dr. Corson of Savannah, Ga., shows an enlarged section of cyst wall in the April A. of S., haematoxylin and eosin stain, C eye-piece and ⅚in objective. Transformation of bone into fibrous tissue is shown. The A. of S. is published by Lippincott at $5 per year, 112 pp. n each number.

Summer Birds.—This contains notes by P. M. Silloway on birds of Flathead Lake, Montana. It is published by the University of Montana at Missoula, Mont. It contains some nice photogravures of bird's nests.

The Cow Pea.—Its value discussed by Experiment farm Supt., Southern Pines, N. C. Copies sent free. 63 pp. numerous illustrations.

A KEY

TO THE

ROTIFERA

Published as the May number of the
American Monthly Microscopical Journal

Chas W Smiley Pub'r
May, 1902

A Key to the Rotifera, for the Amateur.

* A Key to the Rotifera was several years ago (1887), published by the late Dr. Thos. S. Stevens, and although inaccurate, was so useful to the beginner for whom it was exclusively intended, that it is here revised and enlarged by one of his friends with the same object exclusively in view. It is neither the desire nor the province of the editor to struggle with the synonymy or to correct errors of observation. It is said that Gosse misinterpreted the structure of Cœlopus, and that the genus has no rightful existence, but the Key follows Gosse, and the references are chiefly to Hudson and Gosse's Monograph, and its Supplement, with a few exceptions. "J" directs to the "Journal of the Royal Microscopical Society;" "Q" to the "Journal of the Quekett Microscopical Club," with year and page: "Weber" to "Faune Rotatorienne du Bassin du Leman," par E,-F, Weber. The number appended to each Genus in the Key to the Genera, is the number preceding that Genus in the Key to the Species. The editor repeats that the only object of the paper is to help the beginner in his desire for mental recreation: it has no value to those making professional researches.—H. S. M.

GENERA.

¶ Aquatic (a few marine), (A).
¶ Marine, adherent. Ectoparasitic, (B).
A Permanantly adherent, not in social clusters but sometimes in family groups, (§)
A Permanently adherent in social clusters, (§ §)
A Free-swimming, solitary, (§ § §)
A Free-swimming in clusters; tubes cohering, gelatinous ...... Conochilus, 12
B Head and neck distinct; adherent by 1 foot-disc...... Seison. 70
B No distinct head and neck; ,, ,, 1 ,, ,, ...Discopus, 66
B Adherent by 2 pedunculate discs......Saccobdella, 72
B Adherent by hemispherical denticulate foot......Paraseison; 71
§ Corona subcircular or broadly oval, (*)
§ Corona produced into lobes, (**)
§ Corona cup-like, (***)
§§ Clusters fixed; tubes gelatinous, cohering; corona cordate ......Lacinularia, 9
§§ Clusters fixed, without tubes; corona reniform...Megalotrocha, 10
§§§ Free-swimming, creeping like a leech; foot wholly telescopic, (¶¶)
§§§ Free-swimming and sometimes creeping by the toes, (c)
§§§ Free-swimming and skipping by 6 limbs......Pedalion, 65
§§§ Free-swimming only; cilia equatorial; body spherical ......Trochosphæra, 11
* With 2 hooks enclosing the dorsal antenna......Cephalosiphon, 70
* With 2 dorsal hooks, but dorsal antenna absent ......Œcistes, 8
* Without dorsal hooks; foot present; in a tube or not......Œcistes, 8
** Lobes 8, not setigerous; in gelatinous tube......Octotrocha, 80
** Lobes 5, long, slender, erect, convergent......Stephanoceros, 4
** Lobes 4, not setigerous; inhabiting a tube......Melicerta, 5
** Lobes 2—7, setigerous; setæ long, radiating......Floscularia, 1
** Lobes 2, not setigerous; tube usually membranous......Limnias, 6

** Lobe single, frontal, arched ; setæ none ; foot truncate..Acyclus, 2
***Lobe a single, frontal, membranous cup ; foot none........Apsilus, 3
¶¶ Corona two circular, transverse lobes, (a)
¶¶ Corona a flat, ventral, ciliated surface, (b)
a Eyes 2, cervical..Philodina, 13
a Eyes 2, within the frontal column..............................Rotifer, 14
a Eyes 2, frontal ; body exceedingly long and slender..Actinurus, 15
a Eyes none ; body slender, pointed..........................Callidina, 16
b Eyes none ; body smooth, furrowed ; teeth 2..................Adineta, 17
c Illoricate ; foot, when present, not transversely wrinkled, (d)
c Loricate, wholly or partly ; foot various or none, (t)
d Body without skipping appendages, (f)
d Body with skipping appendages, (e)
e Spines in clusters on the shoulders..........................Polyarthra, 22
e Spines single, 2 lateral, 1 ventral..........................Triarthra, 24
e Spines (styles) 2, on the breast..............................Pedetes, 25
f Corona with styligerous prominences, (g)
f Corona without styligerous prominences, (j)
g Ciliated auricles 2 ; body usually obconical ; mastax large
....Synchæta, 21
g Ciliated auricles none ; corona truncate, (h)
g " " " corona transverse, mastax and eye
large..Polyarthra, 22
h Corona without proboscis, (i)
i Eye 1, occipital ; body not conical ; foot retractile..........Notops, 28
i ,, 1, cervical ; body conical ; foot not retractile
....(Cyrtonia*), Notommata, 32
i Eye none ; body obconical......................................Hydatina, 26
i Eye none ; body not conical ; 2 dorsal, 2 ventral antennæ ;
foot retractile..Dinops, 78
j Foot absent, (k)
j Foot furcate, ventral, retractile, (1)
j " " not ventral ; corona without proboscis, (m)
j " " corona with dorsal proboscis bearing 2 eyes
....Rhinops, 28
j Foot stylate ; brain and eye purple..........................Microcodon, 18
j " " with a spur ; eye red..................................Microcodides, 79
j Foot present, toe 1. Vermiform, entoparasitic............Albertia, 29
k Corona subconical, with 2 apices. Viviparous........Asplanchna, 19
k " " with 1 apex ; body sack-like..............Sacculus, 20
1 Body subcylindrical, dorsum gibbous : trophi forcipate
....Triphyllus, 68
1 Body not subcylindrical ; no humps ; rami curved, smooth
....Asplanchnopus, 67
m Body more or less cylindrical, (n)

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* Journal Quekett Micros. Club, 1894, 433.

n Annulose; toes 2; ciliated region ventral..........Taphrocampa, 30
n Not annulose; often soft and versatile, (o)
o With sense-organs in the lumbar region; brain 3-lobed or more..........Copeus, 33
o Without sense-organs in the lumbar region, (p)
p Foot without telescopic joints, (q)
p Foot with telescopic joints; eyes 3..........Eosphora, 36
q Brain conspicuous, often with chalk-masses; eyes and tail present; movements usually active....Notommata, 32
q Brain saccate; eyes 3, cervical, in transverse row; tail bulbous, overhanging..........Triophthalmus, 69
q Brain conspicuous, 3-lobed; tail a minute tubercle; lumbar tentacle single..........Copeus, 33
q Brain conspicuous; eyes and tail none: mallei 1-toothed..........Pleurotrocha, 31
q Brain not specially conspicuous, clear, (r)
r Body with tendency to lumbar enlargement, (s)
r Body without lumbar enlargement, worm-like; ciliated face sub-prone; auricles and tail none..........Proales, 34
s Proboscis fleshy; eyes 2, cervical..........Distemma, 38
s Proboscis often a hook; eyes 2, minute, frontal..........Diglena, 37
s Proboscis none; eye 1, frontal, or none; toes usually long..........Furcularia, 35
t Foot none; lorica bottle-like, smooth..........Pompholyx, 59
t " " lorica-plates connected by membrane..........Anapus, 77
t " " lorica beset with pinnate styles..........Ptœressa, 23
t " " lorica with spines or elastic setæ, (u)
t Foot not transversely wrinkled, not wholly retractile, (v)
t Foot often trans. wrinkled, and often wholly retractile, (ii)
u Front edge always, the anal sometimes, spinous..........Anuræa, 62
u Front edge 6-spined; often produced behind..........Notholca, 63
u Lorica without spines, but with long, rigid styles..........Eretmia, 64
v Lorica without an arched frontal plate, (w)
v Lorica with an arched frontal plate, (z)
w Lorica entire, (x)
w Lorica split down the back, each end open, (gg)
w Lorica split down the ventrum; head with horny plates..........Dispinthera, 74
w Lorica split down the ventrum; gaping behind. Marine..........Mytilia, 56
x Lorica formed of 2 plates, dorsal and ventral, (dd)
x Lorica not formed of 2 plates, (y)
y Lorica cylindrical, open at each end, (bb)
y Lorica pyriform or vasiform, (hh)
y Lorica hemispheric or 3-sided, short..........Cochleare, 57
z Frontal plate a hook, (aa)

z Frontal plate a semi-circular shield.......... Stephanops, 44
aa Toes 2; lorica subspherical, gaping behind.......... Colurus, 53
aa Toes 2; lorica depressed, open at each end.......... Metopidia, 54
aa Toes 2; lorica 3-sided, ridged, flexible.......... Cochleare, 57
aa Toe 1; lorica compressed. Marine.......... Monura, 55
bb Body fusiform or cylindrical, not curved, ; toe 1,
with basal stylets.......... Mastigocerca, 39
bb Body cylindrical, curved, (cc)
cc Toes 2, symmetrical, side by side.......... Rattulus, 40
cc Toes 2, hollow, unequal, triangular, superposed plates
.... Cœlopus, 41
dd Lorica with deep, lateral sinus, covered by flexible
membrane, (ff)
dd Lorica plates dissimilar, forming 2 unequal body-cavities, (ee)
ee Both plates chitinous.......... Euchlanis, 49
ee Ventral plate membranous, or none, flexible, expansile
.... Dapidia, 73
ff Lorica subcircular in outline; toes 2.......... Cathypna, 50
ff Lorica subcircular in outline; toe 1.......... Monostyla, 52
ff Lorica a long ellipse, closed behind; toes 2.......... Distyla, 51
gg Lorica oblong, spinous; eye 1.......... Salpina, 47
gg Lorica not spinous; eye none.......... Diplax, 46
gg Lorica dorsal only, ventral surface naked.......... Diaschiza, 45
gg Lorica of 2 plates, ventral flat, dorsal arched.......... Diplois, 48
hh Lorica dense, shagreened, facetted, with projecting
plates or dorsal spines; foot with spines.......... Dinocharis, 42
hh Lorica thin, smooth, without spines or plates; foot
without spines: toes very long.......... Scaridium, 43
ii Foot ending in a ciliated cup, toes none, (jj)
ii Foot ventral, toe present, (ll)
ii Foot not ventral, ending in 2 toes, (kk)
ii Foot not ventral, with 2 unequal branches, each with
2 unequal toes.......... Schizocerca, 75
jj Lorica sub-circular, entire, flattened.......... Pterodina, 58
kk Lorica without elevated ridges; toes small.......... Brachionus, 60
kk Lorica facetted and covered with points.......... Noteus, 61
ll Lorica areolated, rough, opaque, thick.......... Gomphogaster, 76
ll Lorica smooth, often flexible, a ridge on each side.......... Gastropus, 81

SPECIES.

1. Floscularia. I., 43. Sup. 3.

a Lobes none; coronal setæ very short.......... edentata
a Lobes none; free-swimming.......... pelagica, J., 1893, 444
a Lobes 2, (b)
a Lobes 3, (d)
a Lobes 5, knobbed, (h)
a Lobes 5, not knobbed, (i)

a Lobes 7, knobbed..........regalis

b Adherent; dorsal lobe larger; setæ very short, not vibratile; body long, and narrow..........calva

b Free-swimming, (c)

c Tube apparent; dorsal lobe larger; setæ vibratile..........mutabilis

c Tube none; dorsal lobe hood-like; eye 1; toes 2..........chimæra

d Dorsal lobe with 2, large, flexible processes..........Hoodii

d Dorsal lobe broad, without processes, (e)

e Corona symmetrically dotted; living among Algæ; small..........algicola

e Corona not dotted; not parasitic, (f)

f Setæ a double row, continuous around the margin, (g)

f Setæ a single row, not continuous; 2 small lateral lobes present..........ambigua

g Dorsal lobe hood-like..........cucullata, Q., 1894, 335

g Dorsal lobe not hood-like; interlobular depressions very deep..........trilobata

h Lobes linear: setæ not vibratile..........coronetta

h Lobes linear; setæ very long, in constant motion..........mira

h Lobes triangular; with a dorsal process..........cornuta

h " " no dorsal process..........ornata

h Lobes very short, knobs subsessile..........cyclops

i Lobes pointed, very long and slender; setæ in 2 opposite rows..........Millsii. Sup.

i Lobes pointed, dorsal largest, lateral smallest; peduncle long..........longicaudata

i Lobes broad, (k)

k Dorsal long, trifid; foot twice body-length..........trifidlobata, Q., 1895, 77

k Dorsal lobe arched, its setæ pointing downward..........torquilobata, J, 1891, 302

k Dorsal lobe broad, coronal margin with short spines; setæ long..........spinata Q., 1893, 281

k Dorsal lobe broad; no spines; setæ radiating and continuous..........campanulata

2. ACYCLUS. I., 57.

Only one species..........inquietus

3. APSILUS. I., 58. J., 1896, 269.

a Coronal cup and its frontal margin oblique, (b)

a Coronal cup and its frontal margin horizontal; ganglion?..........vorax

b Ganglion cervical, (c)

b Ganglion on dorsal wall of cup..........lentiformis

c Ventral border of cup with central, convex, lobe-like projection..........bipera

c Ventral border of cup even, without central lobe..........bucinedax

4. Stephanoceros. I., 60.

Only one species........................Eichhornii

5. Melicerta. I., 67.

a Pellets subspherical; lobes wider than the tube........ringens
b Pellets pointed, cylindric; lobes as wide as the tube........conifer
c Pellets ovoid, large; upper lobes deeply separated........Janus
d Pellets none, tube gelatinous; lobes thrice the body-width........tubicolaria

6. Limnias. I., 75. Sup. 4.

a Tube straight. (b)
a Tube curved or twisted, (c)
b Tube transversely ringed or ridged........annulata
b Tube not ringed or ridged, colorless........Ceratophylli
b Tube yellow, cylindrical, strewn with brown granules..granulosa
b Tube widening upward, clear below, floccose above, beset with transverse rows of minute points..Shiawasseensis. Sup
c Tube obscurely ringed, both ends clear; ventral antennæ 2, very long........cornuella. Sup
c Tube opaque, base solid, tapering; 2 horny processes on dorsum below the corona........Myriophylli Q., 1891, 320

7. Cephalosiphon, I., 77.

a Tube membranous, tapering to the base........limnias
a Tube gelatinous, irregular, semi-transparent........candidus

8. Œcistes. I., 79. Sup. 5.

A Tube short or none; foot twice or thrice the body-length, (a)
A " " " " foot not longer than the body........velatus
A Tube floccose, irregular, (b)
A Tube gelatinous, (c)
A Tube of pellets; antennæ long........pilula
A Tube membranous........intermedius
a Two dorsal hooks below the corona, adnate at base....serpentinus
a One minute horny process on dorsum below the corona........mucicola. Sup
a No dorsal hooks; no tube; foot twice body-length; teeth 3........socialis. Sup
b Ventral antennæ long, recurved........longicornis
b " " " corona crossed by thick ribs........umbella
b Ventral antennæ very short, wide apart........crystallinus
b Ventral antennæ none; 2 large, dorsal hooks, adnate for ½ their length........ptygura
c Corona 2-lobed; ventral antennæ long, mobile........brachiatus
c Corona circular: ventral antennæ mere tubercles........stygis
c Corona subcircular; ventral antennæ stout, not long; foot short........brevis. J., 1893, 448

9. LACINULARIA, I., 85. Sup. 7.

a Not yellow; antennæ none..........socialis
a " " two species from China. J., 1893, 149
a Yellow; peduncle ½ inch long. Australia..........pedunculata. Sup

10. MEGALOTROCHA. I., 86. Sup. 7.

a Four opaque warts on breast..........alboflavicans
a Two opaque warts on breast..........semi-bullata, Sup
a Two species from China. J., 1893, 150.

11. TROCHOSPHÆRA. I., 88. J., 1893, 147.

a Ciliary wreath dividing the sphere into
  2 equal parts..........equatorialis
  2 unequal parts....China..........solstitialis

12. CONOCHILUS. I., 89.

a Tubes coherent, gelatinous; individuals many..........volvox
a " " individuals 2—7; 1 large antenna near center of corona..........unicornis. Q., 1892, 367
a Tubes distinct; cluster 1 adult and few young..........dossuarius

13. PHILODINA. I., 97. Sup. 7.

A Body colorless; fresh water, (a)
A " " marine; eyes pectoral, small..........microps. Sup
A Body not colorless, (c)
a With thick, bulging collar; corona sulcus broad, shallow..........erythrophthalma
a Without cervical swelling or constriction, (b)
b Teeth 2; foot thick, spurs large. Commensal on Asellus vulgaris..........commensalis. Q., 1893, 156
b Teeth 2; toes 4; corona very wide, sulcus very small; antenna 3-jointed, decurved, unisetate..........megalotrocha
b Teeth 3, thick; body much fluted; end joint of antenna clavate, 3-lobed..........macrostyla. Sup
c Dark brown; beset with spines..........aculeata
c " " end joint of antenna 3-lobed; teeth 3..........tuberculata
c Yellow: neck constricted; foot slender..........citrina
c Ruddy, translucent, not constricted; foot 5-jointed, stout....roseola
c White; antenna 2-jointed; teeth 2; foot 6-jointed, toes 4; spurs large, stout. In flocculent colonies..........socialis*

14. ROTIFER. I., 103. Sup. 8.

A Tube none, (a)
A Tube present, floccose, crooked..........mento†
a Body white, (b)
a Body hyaline, with longitudinal folds, (c)

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*Craig. Proc. Nat. Sci. Ass'n., Staten Island, 1896, 18

† From India. Found here by Jennings, Bul. Michigan Fish Commission, No. 3, 1894.

a Body brown, (d)
a Body gray, (e)
b Gradually tapering to the foot.......................vulgaris
b Suddenly attenuated to the very long, slender foot;
  body hyaline at the ends.......................macrurus
c Dorsal antenna very long and mobile; corona large......macroceros
d Dull brown, viscous; dorsal antenna large, top
  swollen.......................tardus
d Clear brown, not viscous; antenna long, stout.
  motionless.......................hapticus
e Spurs short, thick at base; toes usually retracted, not easily
  seen; body tapering to the foot..elongatus. Sup. Weber
e Spurs long, slender; toes long, 3-jointed, usually extended:
  body not tapering.................trisecatus. Sup. Weber

15. Actinurus. I., 109. Sup. 8.

One species.......................neptunius

16. Callidina. I., 109. Sup. 8.

a Frontal column without hooks, (b)
a Frontal column with 2 curved hooks..................bihamata
a " " " 1 decurved, acute hook..........pigra. Sup
b Not commensal nor parasitic, (c)
b Commensal or parasitic, (f)
b In cups and leaves of Jungermanniæ, (i)
b In mosses, (Sphagnum and others), (j)
c Body without spines or points, (d)
c Body with spines, posterior 8, rough, anterior 4;
  longitudinal ridges 14; toes 4, in 2............
  unequal pairs; teeth 2............cataracta. Q. 1898, 75
d Four spurs, 2 on top of foot...............quadricornifera, Sup
d Two spurs or none, (e)
e Body transversely corrugated; teeth 2; spurs minute,
  conical.......................bidens
f On larva of Psephanus, (g)
f On Gammarus and Asellus, (h)
g Dorsal antenna ended by many, small, setiferous,
  pointed elevations.......................socialis. Sup
h Dorsal antenna small, tip a ciliated cup with
  hood-like projection......magna-calcarata. Q., 1892, 378
h Dorsal antenna large, tip 3-lobed, without setæ........parasitica
i Teeth 2 on one ramus, 3 on other................symbiotica. Sup
i Teeth 5 on one ramus, 6 on other.................Leitgebii. Sup
j Body with spines, points, knobs, or frontal horns, (k)
j Body with longitudinal skin-folds, (l)
j Body without skin-folds, (o)
k With 2 fronto-lateral, fleshy horns........cornigera. Q., 1893, 196

k With 6, anterior, knob-like prominences; skin rough, stippled....................alpium. Q., 1894, 442

k With prickle-like points; 1 ventral, 2 lateral spines; toes crescentic..................spinosa. Q., 1892, 22

k With blunt points; teeth2; spurs small, conical....aspera. Q., 1892

k With 1 anterior, 1 central row of short spines; furrowed..Brycei. Weber, 347

l Skin-folds both dorsal and lateral, (m)

l Skin-folds lateral only, (n)

m Two dorsal, cervical tubercles; body brown, opaque; head and foot colorless; spurs 3-jointed..............................longirostris. Q., 1893, 159

m No tubercles; central skin-folds extending over swollen, posterior segment ....plicata. Q. 1892, 449

m No tubercles; skin rough, viscid; 1 ventral, 2 lateral cervical swellings; teeth 5 or 6........fusca. Q., 1894, 449

n Case present, flask-shaped; ciliary discs on high, diverging pedicels, a tooth in the deep sulcus ....eremita. Q., 1894, 449

n Case none; corona ½ wider than neck; foot 4-jointed; toes 4 ....plena. Q., 1894, 450

n Case none; corona ¼ wider than neck; foot 3-jointed; toes 3..habita. Q., 1894, 457

n Case none; corona about as wide as neck; body stout, much flattened and broadest near the middle..lata. Q., 1892, 22

o Spurs on cushion-like swellings; teeth 4; body yellowish-white ....tetraodon.Q., 1894, 440

o Spurs not seated on cushions, (p)

p Teeth 5 to 7; corona large; upper lip wide, even; terminal foot-joint with perforate, reniform disc..russeola. Q., 1894, 445

p Teeth 4 in one ramus, 3 in the other; ciliary discs ½ front width..pusilla. Q., 1893, 201

p Teeth 2, (q)

q Coronal discs large, flat; spurs perforate, wide apart..................vorax. Q., 1894, 446. Weber, 346

q Corona rarely displayed, exactly the width of the neck; spurs near together......Ehrenbergii. Q., 1894, 441

q Corona narrow, about equal to neck; a pointed swelling on each side of the mouth ....angusta. Q., 1894, 451

17. ADINETA. I., 112. Sup. 12.

a Spurs twice the length of the three toes; eyes 2; teeth 2; body fusiform..oculata. Sup

a Spurs short, pointed; body furrowed, colorless........................ vaga a Spurs none; foot ending in a disc-like sucker, with 10 posterior papillæ; body with lateral skin-folds. In moss.................. clauda. Q., 1893, 150

18. Microcodon. I., 118.

Only one species..................clavus

19. Asplanchna. I., 120. Sup. 12.

a Female with 4 humps; eye single..................Ebbesbornii
a Female with 3 humps; eye single.................. amphora. Sup
a Female with no humps; eye single. (b)
a Female with no humps; eyes 3, (c)
b Male without humps..................Brightwellii
b Male with 4 humps; female like Brightwellii.........Sieboldii. Sup
b Male with 2 humps; female like Brightwellii......intermedia. Sup
c Head truncate; 1 cervical eye, 2 smaller, submarginal; ovary a transverse ribbon..........triophthalma. Sup
c Head convex or conical; eyes in a nearly straight row; ovary roundish..................priodonta

20. Sacculus. I., 124. Sup. 16. (Ascomorpha, Perty.)

a No longitudinal ridges; head conical, yellow, with triangular, dorsal, basal process..........Germanicus. Sup
a No longitudinal ridges; sac-like; head conical, no process..viridis
a No longitudinal ridges; head with long, dorsal, straight, antennal process..................orbicularis. *
a Four ridges; head truncate, with lip-shaped, dorsal process..................saltans, Sup
a Two lateral, subdorsal grooves; head depressed; hyaline..................hyalinus. Sup

21. Synchæta. I., 125. Sup. 17.

a Fresh-water, (b)
a Marine, luminous; cylindric, conical behind..................Baltica
b Body a swollen cone, (c)
b Body a slender cone; head truncate, auricles in its plane..tremula
b Body ovate or pyriform; head very large, auricles wide, rounded; foot none, toe 1, minute..................oblonga
c Auricles long, pointed, pendent..................pectinata
c Auricles long, pointed; foot long, rhomboid, toes 2..longipes. Sup
c Auricles large, rounded; foot long, slender..................stylata. †

22. Polyarthra. II., 3.

a Spines 12, narrow.................. platyptera
a Spines 12, broad, leaf-like..................euryptera. Q., 1896, 267
a Spines absent..................aptera. Q., 1893, 281

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* Kellicott. Trans. Am. Micros. Soc., 1897, 46.
†Jennings. Bul. Mich. Fish Com., 1894, 10.

23. Pterœssa. II., 4.

a Pinnæ 24, in 6 longitudinal rows; horny-yellow .... surda

24. Triarthra. II., 5. Sup. 18.

a Spines more than twice the body length, imbricated ...... longiseta
a Spines more than twice the body length, not imbricated; base of unpaired spine postero-terminal .. terminalis. Sup
a Spines not twice the oval body-length .... mystacina
a Spines not ¼ the cylindrical body-length .... breviseta

25. Pedetes. II., 8.

Leaping styles twice the body-length .... saltator

26. Hydatina. II., 9.

One species .... senta

27. Rhinops. II., 10.

One species .... vitrea

28. Notops. II., 11.

a Foot wholly retractile, (b)
a Foot not wholly retractile, not ventral .... brachionus
b Flask-shaped, about 1-270 in. long; foot very small; trophi forcipate .... minor. Q., 1892, 359
b Flask-shaped; foot long, cylindrical; trophi not forcipate .... pygmæus. J., 1893, 444
b Sac-shaped, much compressed; trophi forcipate .... hyptopus
b Sac-shaped; trophi malleate .... clavulatus
b Ovate, ventrum flat; a red spot on each side of mastax .. pelagicus*
b One species from China .... lotos. J., 1893, 152

29. Albertia. II., 15. Sup. 20.

a Length 1-100 inch; subcylindrical; foot 1-jointed; toe small. In Nais .... intrusor
a Length 1-270 in.; toe a soft papilla. In Nais .... naidis
a Length 1-55 in.; toe none....Intestine of earthworms and slugs .... vermicularis. Sup

30. Taphrocampa. II., 16. Sup. 20.

a Body cylindric, (b)
a Body fusiform or tapering, (c)
b Brain clear; eyes 2; front with decurved hood ....nitida. Q., 1898, 75
b Brain large, long, clavate, with moving granules; body-margin undulate .... clavigera†
b Brain opaque; toes thick, acute .... annulosa
c Brain clear; front with recurved hood; tail present .... Saundersiæ
c Brain opaque; eye 1; toes a wide crescent .... selenura. Sup

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* Jennings. Bul. U. S. Fish Com., 1899, 82.

† Stokes. Ann. & Mag. Nat. Hist., 1896, 18.

31. PLEUROTROCHA. II., 19.

a Toes moderately long, acute, straight..........constrictor
a Toes slender, acute, slightly decurved..........leptura
a Toes tapering, long as body, bases separated. Parasitic..parasitica*
a Toes broad, nearly straight..........gibba

32. NOTOMMATA. II., 20. Sup. 22.

A Brain more or less opaque, (a)
A Brain clear, (d)
a Body subcylindrical, (b)
a Body saccate, long or slender, (c)
a Body vermiform, soft; alimentary canal apparently annulate; toes long, decurved..........limax. Sup
a Body rhomboid in outline; auricles large, globose: brain pointed.......... pilarius
b Auricles invisible; brain intensely opaque; toes long, decurved..........crytopus
b Auricles small rounded; dorsum rounded; tail with basal knob; toes broad, conical..........tripus
b Auricles small; corona long, oblique; neck large, swollen; toes minute; brain 3-lobed.......... collaris
b Auricles large; corona prone, long; body orange-brown; toes short, conical..........truncata†
b Auricles large; body ventricose; head wide; tail minute......aurita
b Auricles large, stalked; body with transverse constrictions; brain long..........torulosa
b Auricles large, stalked; corona circular, with crenate fringe; each side of the body with rounded projection; toe 1 acute..........monopus‡
b Auricles large, enclosed by rounded membrane; corona prone; front with decurved process..........vorax†
c Body large, tapering to small foot; toes minute; auricles small..........forcipata
c Body slender, both ends pointed; face prone, very long, chin prominent..........saccigera
d Body cylindrical, or cuneate, (e)
d Body fusiform, (g)
d Body flat, Oniscus-like; teeth many; toes rather long..........launiscifornis. Sup
d Body globose, very small; back arched; toes 2, decurved, acute..........ovulum. Sup
d Body obconical, hyaline; corona transverse and prone; foot long, tapering to 2 short, acute toes..........tuba. (Cyrtonia. Q., 1894, 433)

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* Jennings. Bul. U. S. Fish Com., 1899, 84.
† Jennings. Bul. Mich. Fish Com., 1894, 14.
‡ Stokes. Ann. & Mag. Nat. Hist., 1897, 628.

e Auricles present, (f)
e Auricles not seen; foot straight, protrusile as long as the trunk; eye frontal, small.................Theodora. Sup
f Auricles cylindric, oblique; body tapering to long foot; toes short.................potamis. Sup
f Auricles rounded, small; body broadly truncate; toes long; trophi forcipate.................lacinulata. (Diaschiza. Weber, 545)
f Auricles, rounded, small; toes long. Like aurita.................ansata
f Auricles rounded, the setæ very long; body cuneate; toes curved, ⅓ body-length......cuneata. J., 1891, 305
g Head broad, auricles obscure; foot long; toes short, acute. Length 1-150 inch.................nais
g Head narrow, auricles small; foot invisible; toes minute. Length 1-130 inch.................brachyota

33. Copeus. II., 28. Sup. 19.

a Lumbar organs one or more setæ on each side, (b)
a Lumbar organs tubules setigerous at the summit, (c)
a Lumbar organs a single, postero-dorsal tentacle; antenna 1; auricles none.................caudatus
a Lumbar organs none; auricles small; brain 3-lobed........Cerberus
b Auricles long, tubuliform; lip long, ventral, ciliated; foot 2-jointed, a tubercle between the long toes..........labiatus
b Auricles long, thick; no long lip; no digital tubercle; foot 3-jointed; tail stiff, pointed..... Ehrenbergii. Sup
b Auricles, large, oval, thin, disc-like; toes unlike; tail cylindric.................Americanus*
c Brain 3-lobed; tail bag-like, sub-globose; antenna 1, short.................pachyurus
c Brain 3-lobed; 2 occipital antennæ.................spicatus
c Brain 5-lobed; 1 antenna.................quinquelobatus. J., 1896, 269

34. Proales. II., 36. Sup. 23.

A Not parasitic; often among Algæ, (a)
A Parasitic in Volvox: foot and toes none.................parasita
A Parasitic in Vaucheria-galls; toes small, straight..Wernickii. Sup
a Foot present, more or less stout, (b)
a Foot undeveloped, toes minute; body slender, vermif'm..decipiens
b Body cylindric or fusiform, (c)
b Body bottle-shaped, belly flat; foot short; toes blade-shaped, straight, acute.................prehensor. Sup
c Toes slender, pointed, foot stout, (d)
c Toes minute, (e)
c Toes and foot both long, sigmoid; body curved.................tigridia
c Toes rod-shaped, base thick, tapering, obtuse, long..coryneger. Sup

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* Pell. The Microscope, 1890, 144.

d Proboscis large, fleshy, decurved; body cylindric, slender......felis
d Proboscis none; body compressed; back arched; toes decurved ....gibba
e Foot broad, with median depression; head broad, truncate..sordida
e Foot long, stout, very distinct; body ovate.......... petromyzon
e Foot long, stout; body fusiform, head distinct..........laurentinus*
e Foot minute; mastax forcibly protrusile..........orthodon. Sup
e Foot minute; mastax not protrusile; eye l'ge, in 2 parts..algicola†

35. Furcularia. II., 40. Sup. 25.

A Toes longer than the body, unequal, (a)
A Toes longer than the body, equal..........æqualis
A Toes shorter than the body, (b)
a Two large, red, lumbar spots. Length 1-60 inch ....grandis. Q., 1895, 124
a No lumbar spots. Length about 1-100 inch ....longiseta
b Toes blade-shaped, not notched, (c)
b Toes not blade-shaped, not notched, (d)
b Toes blade-shaped, notched with 2 teeth..........forficula
b Toes blade-shaped, notched with 3 teeth..tubiformis. Q., 1893, 139
c Fresh-water; foot-joints none; eye none; body gibbous..ensifera
c Fresh-water; foot long; eye 1; body ovate; head truncate..........molaris. Sup
c Marine; toes small; body long, cylindric..........marina
d Toes more or less decurved, often only at the tip, (e)
d Toes straight, often short, conical, (f)
e Foot and toes as long as the trunk; tail pointed........lactistes. Sup
e Foot and toes shorter; head truncate; tail decurved, acute ....sterea. Sup
e Foot and toes shorter; head rounded; neck constricted..........cæca
f Toes minute, conical; eye none..........micropus
f Toes ½ foot-length, conical; eye 1..........Boltoni
f Toes about ½ body-length, (h)
f Toes about ¼ body-length, (g)
f Toes less than ¼ body-length, (i)
g Toes basally broad, tapering to long points..........lophyra. Sup
g Toes slender; front rounded; body slender..........gracilis
h Toes stylate; back convex, abruptly falling off to foot..........gibba
h Toes basally thick, abruptly attenuated..........Eva. Sup
i Toes conical, ending in long, soft points; foot large ....melandocus. Sup
i Toes small, acute; foot short; body globose..........sphærica. Sup

36. Eosphora. II., 47. Sup. 28.

a Head separated by a neck; auricles present..........aurita

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* Jennings. Bul. Mich. Fish Com., 1894, 12.
† Kellicott. Trans. Am. Micros. Soc., 1897, 48.

a Head separated by a neck; auricles none (or small); body sub-fusiform, front truncate......elongata. Sup
b Neck inconspicuous; auricles small; foot narrow, conical..........nais. Sup
b Neck inconspicuous; auricles small; foot broad, conical..........digitata. Sup

37. DIGLENA. II., 48. Sup. 28.

A Toes straight, (a)
A Toes decurved, (f)
A Toes incurved, slender; body-ends slender, middle gibbous; proboscis acute..........circinator
A Toes scythe-shaped; face long, prone; trophi forcipate..forcipata
a Foot thick, short; toes short, (b)
a Foot thick, short; toes long, slender, (c)
a Foot thick, long; body soft, changeable; front truncate; rear tapering to foot..........permollis
a Foot taper or conical; body slender, necked; front beaked..giraffa
a Foot taper or conical; body ovate; no neck; front truncate..........conura. Sup
a Foot bulbous, large (d)
a Foot minute or none, (e)
b Body gibbous behind; face overhung by hood......mustella. Sup
b Body gibbous behind, overhanging the foot; face with a small beak..........contorta*
b Body cylindric, ends truncate; toes ventral, at right angle to body..........catellina
c Body long, slender; front truncate; eyes 2, colorless; toes long..........caudata
c Body oblong, centrally swollen; front rounded; eyes 2, close together..........biraphis
c Body fusiform; head beaked; toes basally thick, diminishing to obtuse rods..........aquila. Sup
d Body massive; head rounded, beaked; face sub-prone......grandis
e Toes long; foot none; body conical, front oblique..capitata. Sup
e Toes small, acute; foot minute; body long, annulose, larviform; front beaked..........Rosa. Sup
e Toes minute, conical; body cylindric, ending in 2 or 3 soft lobes..........silpha. Sup
f Body in transparent leathery sheath; front beak small; toes long..........gibber
f Body not in sheath, (g)
g Foot short, toes long, blade-like; face oblique, overhung by hood..........uncinata. Sup
g F't short; toes long, slender; skin leathery, in folds..pachida. Sup

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* Stokes. Ann. & Mag. Nat. Hist., 1897, 630.

g Foot short; toes minute; face sub-prone; beak small, tubercular ....suilla. Sup

g Foot long, slender; toes long; front rounded; beak or hood none ....clastopis

38. DISTEMMA. II., 54. Sup. 31.

a Body gibbous, slender; foot long, toes minute ....labiatum

a Body gibbous behind, long, changeable. Marine ....raptor

b Body cylindric, long; toes ⅓ entire length ....Collinsii

b Body cylindricconical; toes recurved, base toothed..forficula. Sup

c Body sub-fusiform; eyes 2, colorless, occipital; toes slightly decurved........platyceps. Sup

39. MASTIGOCERCA. II., 59. Sup. 35.

A Lorica with 2 longitudinal ridges, (a)

A Lorica with 1 longitudinal ridge, (b)

A Lorica not ridged, (f)

a Ridges sub-parallel, nearly as long as lorica........bicristata. Sup

a Ridges diverging anteriorly, about ½ lorica-length........mucosa[*]

a Ridges diverging anteriorly, equaling lorica-length; a thorn before each lateral antenna........spinigera[†]

b Lorica without frontal spines, (c)

b Lorica with 3 frontal spines........scipio

b Lorica with 5 frontal spines........cornuta

c Toe longer than lorica, (d)

c Toe shorter than lorica, (e)

c Toe as long as lorica; basal styles 2, minute........elongata

d Ridge as long as lorica; 2 postero-dorsal spines........bicuspes[‡]

d Ridge ½ lorica-length........carinata

d Ridge ⅔ lorica-length........rattus

e Sub-styles 2, unequal........lophoessa

e Sub-styles (under pressure) 3, unequal........iernis. Sup.

f Lorica without frontal spines (g)

f Lorica with 1 stout, tooth-like, frontal spine; necked..multicrinis[§]

f Lorica with 2 unequal frontal spines; toe-base bulbous, sub-styles small........bicornis

g Toes more than ½ length of broadly ovate body; sub-styles 3..lata[‖]

g Toe ½ length of fusiform body; sub-styles present........macera

g Toes less than ½ body-length; sub-styles none........stylata

40. RATTULUS. II., 64.

a Sub-styles present, (b)

a Sub-styles none; probably visible under pressure, (c)

b Sub-styles 4; toes long, unequal........trigis

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[*] Stokes. Ann. & Mag. Nat. Hist., 1896, 17. [†] Ib., 1897, 631. [‡] Pell. Microscope, 1890, 143. [§] Kellicott. Trans. Am. Micros. Soc., 1897, 51. [‖] Jennings. Bull. Mich. Fish. Com., 1894, 19.

b Substyles 4 (under pressure); toes short; lorica with 2 deep anterior grooves........sulcatus[*]
b Subst.3; toes unequal; occip.spines 2,eq'l..bicornis. Q.,'93, 159, 308
b Substyles 2 or 4; lorica stippled, movements often forming a ridge-like collar........collaris. Q., 1896, 266
b Substyles 2; lorica with 1 anterior groove........brachiurus
c Brain opaque; toes blade-like; skin flexible........cimolius
c Br. clear; body slender, width less than 1-5 length....helminthodes
c Br. clear; body stout; face w.pendent flesh-lobes.Marine..calyptus
c Brain clear; body stout; toes wide apart........sejunctipes
c Brain clear; body stout; toes not separated........palpitatus[†]

41. CŒLOPUS. II., 67.

a Lorica not ridged, (b)
a Lorica ridged; head with 2 spines; body short, plump....porcellus
b Head with 2 or 3 spines; substyles 2........tenuior
b Head without spines, (c)
c Body short, plump; toe shorter than body-depth........brachyurus
c Body globose, very protuberant behind........cavia
c Body rotund, minute; eyes 2, wide apart........minutus

42. DINOCHARIS. II., 71.

a Lorica without spines, (b)
a Lorica with dorsal spines, (c)
b A short spine between the toes........pocillum
b No spine between the toes........tetractis
c Spurs straight; spines 8........collinsii
c Spurs none; spines 8. China........sericea. J., 1893, 152.

43. SCARIDIUM. II., 73.

a Toes, foot and body about equal in length........longicaudum
a Toes as long as body and foot together........eudactylotum

44. STEPHANOPS. II., 75. Sup. 36.

a Lorica without spines or points, (b)
a Lorica with 1 long, dorsal spine, (c)
a Lorica ending behind in 3 spines; foot with spine........lamellaris
a Lor. do. in 3 points; foot without spines..intermedius. Weber, 534
a Lorica ending behind in 2 spines........cirratus. Sup
b Lorica cylindric, with thick neck........muticus
b Lorica flattened; toes decurved, divergent........stylatus. Sup
c Foot without spinous tail; body fusiform........leydigii. Sup
c Foot with spinous tail, (d)
d Dorsal spine curved; foot jointless (?)........tripus. Sup
d Dorsal spine curved; foot 3-jointed....longispinatus. Weber, 536[‡]

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[*] Jennings. Bul. U. S. Fish Com., 1894, 20.

[†] Stokes. Ann. & Mag. Nat. Hist., 1896, 25.

[‡] Weber identifies unisetatus, leydigii and tripus with longispinatus.

d Dorsal spine straight; lorica ovate ....unisetatus

45, DIASCHIZA. II., 77. Sup. 37.

A Dorsal cleft narrow; the edges parallel, (a)
A Dorsal cl. do., diverging slightly in front..lacinulata. Weber, 545
A Dorsal cleft narrow; closed in front, gaping behind, (d)
A Dorsal cleft wide throughout, (e)
a Toes blade-shaped, (b)
a Toes not blade-shaped, (c)
b Toes abruptly shouldered; dorsum squarely gibbous....cupha. Sup
b Toes even; body gibbous and swollen behind........ ....hoodii
b Toes even; body thick, front widest; cleft ridged......................pæta
b Marine. Lorica pyriform; head beaked....................fretalis. Sup
c Lorica flexible, constantly wrinkling; minute, 1-350 inch..exigua
c Lorica not flexible, decurved; toes long, slender.......... ....valga
c Lorica do., ellipt'l; toes long, stout; trophi proj..ramphigera. Sup
d Head brdr. than body; face very oblique..megalocephala. Q, '95, 123
d Head globose, prominent; lorica laterally cordate..acronota. Sup
d Head large, prominent; body cylindric, compressed....semiaperta
e Body subcylindric; toes thick, obtuse....... .... tenuior
e Body subpyriform; a ring girdling the round front; toes slender, acute... ....globata. Sup

46. DIPLAX. II., 81.

a Lateral outline nearly a parallelogram.............. .... compressa
a Lateral outline ovate; transverse section triangular..........trigona

47. SALPINA. II., 82. Sup. 38.

a Lorica more or less extensively stippled, (b)
a Lorica not stippled, (f)
b Occipital spines none, (c)
b Occipital spines two, (e)
c Lorica w. stip'l'd collar; pect'l spines short, upt'n'd hooks..similis*
c Lorica w. do.; pectoral spines short, not hooked......ventralis. Sup
c Lorica-surface more or less stippled, (d)
d Pectoral spines straight; alvine 2, short, recurved........brevispina
d Pectoral spines incurved; alvine long, incurved...... ....eustala
d Pect'l spines 2-p'nt'd; teeth 2 rows in each uncus (?) polyodonta. Sup
e Occip'l spines mov'ly jointd to lorica; posterior sp. no..macrocera†
e Occip'l sp. not j'ntd; alvine 2, rec'rv'd, sinus wide, deep..mucronata
e Occip'l spines do.; alvine decurved, sinuses straight........spinigera
e Occip'l spines do.; alvine stout, sinus angular. Marine..marina. Sup
f Occipital spines none, (g)
f Occipital spines two, often short, (h)
g Lumbar spine straight, shorter than alvine............... macracantha
g Lumbar spine curved, longer than alvine. Australia........cortina

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* Stokes. Ann. & Mag. Nat. Hist., 1896, 24.

† Jennings. Bul. Mich. Fish Com., 1894, 22.

h Occip'l sp. straight, v. short. Lorica-l'gth 1-200 in..bicarinata. Sup
h Occip'l spines curved; dorsal cleft wide, edges out-curved....sulcata

48. DIPLOIS. II., 86.

a Dorsal cleft parallel, narrow; toes long, narrow..trigona. Q.,'95,119
a Dorsal cleft parallel, narrow; toes blade-shaped................daviesiæ
a Dorsal cleft wide before, closed behind; ventral plate with 3 rear spines......................(Euchlanis subversa) propatula

49. EUCHLANIS. II., 88. Sup. 39.

A Lorica oval, (a)
A Lorica ovate, (b)
A Lorica ovately-oblong; foot long; hind dorsal edge with deep gap..pannonica. Sup
A Lorica conical, dorsal ridge concave; teeth 3..............conica. Sup
A Lorica roof-shaped, not ridged, sides sloping.... ....oropha. Sup
A Lorica constricted in middle, pyriform; toes rod-like..pyriformis
a Hind dorsal edge notched; median dorsal plate upright.... triquetra
a Hind dorsal edge rounded; lorica long, narrow............................lyra
b Hind dorsal edge with deep gap, (c)
b Hind dorsal edge notched; ventral gap wide; toes broad....deflexa
b Hind dorsal and ventral edges rounded; toes long, rod-like...(Diplois) subversa
c Lorica broad; teeth 5 in each uncus ....dilatata
c Lorica narrower; teeth 7 (?) in each uncus ....macrura

50. CATHYPNA. II., 94. Sup. 41.

a Lorica-surface smooth, (b)
a Lorica-surface punctate, (e)
a Lorica-surface broadly facetted, (d)
a Lorica-sfce fluted; front edges stra't; toes blade-shaped....sulcata
b Claw 2-shldrd, toes sli'tly blade-shpd; lor. high behind..diomis. Sup
b Claw 1-shouldered, toes rod-like, (c)
b Claw not shldrd, toes blade-shpd; front edge stra't..latifrons. Sup
c Lorica front edge nearly straight ....ungulata. Sup
c Lorica front edge crescentic.................... . ...luna
d Toes blade-shaped; front opening very narrow..................rusticula
d Toes rod-like; 2 posterior spines..............................(Distyla) stokesii[*]
e Hind border n'r'w, concave, ends p'nt'd; front excavate..scutaria[†]
e Hind border broad, rounded; front nearly straight....glandulosa[†]

51. DISTYLA. II., 96. Sup. 42.

a Toes rod-like, not shouldered, (b)
a Toes rod-like, obsc'ly 2-shldd; lor. front trncte, rear rndd..gissensis
a Toes blade-shpd, not shldrd; loriça nar'ow, flexible, fluted..flexilis
a Toes do.; lorica flask-shaped, skin-like, flexible............lipara. Sup
a Toes blade-shpd, 1-shldrd; lorica-front trncte, rear r'nded..inermis

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[*] Pell. The Microscope, 1890, 143.

[†] Stokes. Ann. & Mag. Nat. Hist., 1897, 631.

a Toes scythe-shaped, base wide apart; lorica tesselated,
pointed behind ....ludwigii. Sup
b Lorica smooth, semi-orbicular, front truncate....hornemanni. Sup
b Lorica rough with crescentic elevations........................signifera*
b Lorica fluted, front with 2 lateral points....................striata. Sup
b Lorica facetted; 2 postero-lateral thorns; toes
curved..spinifera. Q., 1894, 427
b Lorica facetted; 2 terminal spines ....(Cathypna) stokesii

52. Monostyla. II., 97. Sup. 44.

a Claw between 2 slender spines, (b)
a Claw 2-shouldered, (c)
a Claw not shouldered nor spinous, (e)
b Frontal points wide, triangular; lorica broadly ovate.......lunaris
b Frontal points small, incurved, distinct; lorica-outline
sub-circular...robusta§
b Frontal points small, not incurved; lorica broadly oval......bipes§
c Dorsum tesselated; hind excavation 3 sides of a square........lordii
c Dorsum not tesselated, (d)
d Lorica-outline sub-circular; front with 2 wide, decurved
spines..quadridentata
d Lor.-outl. obl'ng; sub-cylindric,soft,flexible, skin-like..mollis.Sup
d Lorica-ontline oval; transverse section sub-circular..............bulla
e Foot (toe) fusiform; jaws triangular.................closterocerca. Sup
e Foot bulbous; toe slightly blade-shaped..............................cornuta
e Foot bulbous; toe not blade-shaped.................................hamata‡

53. Colurus. II., 101. Sup. 45.

A Fresh-water, (a)
A Marine, (g)
a Lorica dorsally ovate or oval; not crested, (b)
a Lor. dorsally ovate, w. long, stiff, p'nted crest..cristatus. J.,'93,449
a Lor. dorsally pyriform, widest behind; foot and toes long..caudatus
b Lorica ventrally cleft, (c)
b Lorica not cleft..bicuspidatus
c Posterior lorica-end produced into spines, (e)
c Posterior lorica-end not produced into spines, (d)
d Foot small, toes minute, seta-like......................................obtusus
d Foot 4-jointed, toes conspicuous, acute...............agilis. J., 1896, 269
e Dorsal hind points acute, (f)
e Do. blunt; lorica-frontt runcate; ventral cleft wide..........uncinatus
f Dorsal aspect long oval; toe single; foot and toe ½
lorica-length..leptus. Sup
f Dorsal aspect broadly ovate; rear points slight; toes
very slender..micromela. Sup

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* Jennings. Bul. Mich. Fish Com., No. 6, 92.

‡ Stokes. Ann. & Mag. Nat. Hist., 1896, 21. § do 1896, 21

f Dorsal aspect do.; rear spines acute, sinus, wide, deep......deflexus
g Toe not formed of 2 appressed plates, (h)
g Toe a plate within a wider plate, long, slender................cœlopinus
h Hind lorica-ends not pointed, (j)
h Hind lorica-ends 2 short, acute points, (i)
h Hind lorica-ends 2 square points; foot stout, toes minute....pedatus
i Dorsally broad oval; toes 2, stout..............................dumnonius. Sup
i Dors'ly long oval; toe single, with foot ½ lorica-length..leptus. Sup
j Toes 2, (k)
j Toe 1, long, with foot, ⅔ lorica-length; cleft widening at both ends..amblytelus. Sup
k Toes long, slender; tail 2 minute hooks.................decentrus. Sup
k Toes long, slender; tail none; lorica compressed....grallator. Sup
k Toes large, thick, curved; foot short, wide........................dactylotus

54. Metopidia. II., 106. Sup. 46.

A Lorica sub-circular, (a)
A Lorica oval or ovate, (b)
A Lorica oblong, prismatic, with dorsal crest................salpina. Sup
A Lorica elliptical; toes long; eyes 4................................oblonga. Sup
a With 1 dorsal, 2 lateral wings..triptera
a Without wings; dorsal margin milled..solidus
b Lorica more or less punctate, or tesselated, (c)
b Lorica smooth, (d)
c Tesselate; dorsal ridge thin, ventral ½ lorica-length....oxysternum
c Punctate collar present; 2 frontal spines..............................collaris*
c Punctate collar present; 2 frontal points...................................similis*
d Lorica hind end pointed, (e)
d Lorica hind end truncate, (f)
d Lorica hind end rounded or excised, (g)
e Point obtuse; lorica rhomboid-ovate, dorsum roof-like..rhomboides
e Point acute; front angles 2 spines......................................acuminata
e Points 2; eyes 4...bractea
f Dorsum and ventrum equal; margin not excised........ovalis. Sup
f Dorsum and ventrum unequal..lepadella
g Rounded; edges overhanging; toe single (?)............pygmæa. Sup
g Rounded; edges overhanging; toes 2, flexible....parvula. Q.,'93,284
g Rounded; 2 curved frontal spines ....cornuta. Sup
g Excised at both ends; lorica-front broad...........emarginata. Sup

55. Monura. II., 109. Sup. 48.

a Eyes 2, approximate; lorica rounded behind. Marine........colurus
a Eyes 2, distant; lorica acute behind. Marine.............dulcis. Sup
b Eye 1, cervical; toe very long, slender. Marine....loncheres. Sup
b Eye 1, frontal; toe shouldered, more than ½ lorica-length. Aquatic..bartonia. Sup

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* Stokes. Ann. & Mag. Nat. Hist. 1896, 19.

56. MYTILIA. II., 110. Sup. 49.

a Eyes 2, frontal, wide apart......tavina
b Eye 1, cervical; lorica very flexible......pœcilops. Sup
b Eye 1, frontal; skin flexible; body very extensile..producta. Sup
b Eye 1, occipital; toes together wider than foot, abruptly produced......teresa. Sup

57. COCHLEARE. II., 111.

a Lorica hemispheric......staphylinus
a Lorica three-sided......turba

58. Pterodina. II., 112. Sup. 50.

A Lorica sub-circular, (a)
A Lorica elliptical, (d)
A Lorica ovate; commensal on Asellus, (g)
a Lorica inflexible, not laterally folded, (b)
a Lorica sides often folded; gastric glands clavate......valvata
b Lorica without projecting mucro or tooth, (c)
b Lorica with an acute frontal mucro......mucronata
b Lorica with a tooth on each postero-lateral margin......bidentata. Q., 1898, 24
c Front dorsal edge rounded......patina
c Front dorsal edge emarginate......parva. Q., 1898, 24
d Lorica ends truncate. Marine......clypeata
d Lorica ends not truncate, (e)
e Lateral halves bent upward; edges thick, rounded....reflexa. Sup
e Lateral halves bent upward; edges thin, not rounded......incisa*
e Lateral halves not bent upward, (f)
f Commensal on Asellus vulgaris; foot-open'g crescentic..elliptica*
g Eyes absent; dorsal front edge with rounded cone...... cœca*
g A species hardly separable from patina......truncata

59. POMPHOLYX. II, 115.

Lorica with four longitudinal furrows......sulcata
Lor. not furrowed, entire, 2-sided; front obtusely p'nted..complanata

60. BRACHIONUS. II., 116. Sup. 50.

a Frontal spines 10, posterior 4......militaris. Sup
b Frontal spines 8, posterior 4...... polycerus. Sup
c Frontal spines 6, (g)
d Frontal spines 4, (m)
e Frontal spines 3,......tridens
f Frontal spines none or reduced to 1, or to mere teeth, (o)
g Posterior spines none, (h)
g Posterior spines 2, papilla-like......urceolaris
g Posterior spines 2, long, permanent (variable)......bakeri
g Posterior spines 2, long, lost in age, (k)

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* Rousselet. Q., 1898, 24.

g Posterior spines 3........................ ....quadratus. Sup
g Posterior spines 4, (1)
h Anterior spines unequal, (i)
h Anterior spines nearly equal ; dorsum tesselated......leydigii. Sup
h Anterior spines do. ; dorsum not tesselated.......................costulatus
i Hind border more or less concave, (j)
i Hind border nearly plane.. ....longipes. Sup
j Lorica widest behind, hind border rounded .... latissimus. Sup
j Lorica not widest behind, hind border not rounded.
.... bakeri var. rhenanus
k Outer frontal spines longest..................... ....furculatus
k Middle frontal spines longest ....variabilis*
l Lateral spines 2 ; outer post'r spines longest....ancylognathus. Sup
l Lateral spines none ; posterior spines equal ....pustulatus. Sup
l Lateral spines none ; hind spines middle pair shorter
....brevispinus. Sup
m Posterior spines none, (n)
m Posterior spines 5, outer 2 very long..................polyacanthus. Sup
n Lorica surface with minute spinules......................... ....punctatus*
n Lorica tesselated, rough. ....budapestinensis. Sup
n Lorica smooth, frontal spines nearly straight...........................pala
n Lorica smooth, frontal spines, middle 2 incurved....................dorcas
o Frontal spines none, (p)
o Frontal spines merely tooth-like. Aquatic......................... ...rubens
o Frontal spines merely tooth-like. Marine ....mulleri
p Front margin straight, truncate ....mollis*
p Front mar. sli'tly undulate ; 2 blunt processes ebhind.....angularis
p Front margin slighly concave ; lorica smooth..............inermis. Sup
p Front mar. with median cusp; hind spi. 4, curved....gleasonii. Sup

61. NOTEUS. II., 121.

Front with 2 curved strips, hind spines 2, long ....quadricornis

62. ANURÆA. II., 122. Sup. 54.

A Lorica with 6 or more frontal spines, (a)
A Lorica with 4 frontal, no posterior spines, (i)
A Lor. with no spines, formed of 2 plates; front truncate..hypelasma
a Posterior spines none, (b)
a Posterior spines one, (e)
a Posterior spines two, (f)
b Lorica smooth, often tesselated, (c)
b Lorica punctate, stippled, often tesselated, (d)
c Facets on each side of median ridge.. ...tecta
c Facets 5, median; lorica oblong, rounded behind...........curvicornis
c Facets(?) ; lor. obtusely quad'te, rounded behind....squamula. Sup
d Tesselated, the ridges serrate; lorica oblong-square.........serrulata

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* Hempel. Bul. Ill. State Lab. Nat. Hist., IV., 1896, 310.

d Tesselated cruciformly, facets 6. Marine......cruciformis Q.1895,125
d Not tesselated; middle spines sickle-shaped................falculata. Sup
e Lorica ridged, tesselated, spoon-shaped; spine straight..cochlearis
e Lorica ridged, tesselated,oblong ....schista. Sup
e Lor. not rgd, tesselated, subquadrate or triangular..stipitata. Sup
f Posterior spines equal, (g)
f Posterior spines, unequal, (h)
g Lorica quadrate; hind spi. short, frontal straight....testudo. Sup
g Lorica obl.-square; ridges serrate; hind spines short......serrulata
g Lorica oblong-square; ridges not serrate; hind spi. long..aculeata
h Ventrum deep curved; tesselated. Ascension Isl....procurva. J.,'91
h Ventrum flat; anteriorly rough; dorsum tesselated........valga. Sup
h Ventrum do.; sm'th, faintly tesselate. Brisbane...scutata J.'91, 305
i Movable oar-shap'd process each side; sm'th. Marine..biremis. Sup
i No movable process; tesselated. Aquatic............quadridentata. Sup

63. NOTHOLCA. II., 125. Sup. 56.

A Fresh water, (a)
A Marine, (e)
a Posterior spine present, (b)
a Posterior prolongation truncate, (c)
a Posterior border rounded, (d)
b Two frontal spines unequal, 1 long, curved; hind spine very long..............longispina
b Frontal spines sub-equal; lor. longitudinally ridg'd....foliacea. Sup
b Frontal spines sub-equal; lorica wavy-striate............heptodon. Sup
c Prolongation long, tapering; ventrum concave ....acuminata
c Prolongation short, broad, not tapering..............labis. Sup
d Lor. elongated, dorsum with 12 longitudinal striæ........striata. Sup
d Lorica round-pyriform; no striæ; ventral sides sloping, angled.............. polygona. Sup
e Posterior prolongation truncate, (f)
e Posterior prolongation rounded, (g)
f Ridges reaching hind margin; lateral spines dorsal ....hoodii. Q., 1893, 158.
f Ridges reaching hind margin; lateral spines none........thalassia
f Ridges not reaching hind margin; lat.spines present..jugosa. Sup
f Ridges not reaching hind margin; lateral spines none..........scapha
g Dorsum with 12 longitudinal striæ..............striata. Sup
g Dorsum not striated; lorica rhomboidal, front truncate. ....rhomboidea. Sup
g Dorsum not striated; 2 movable lateral spines........spinifera. Sup

64. ERETMIA. II., 128.

Setæ 6; 1 dorsal, 1 ventral, 4 terminal..............cubeutes
Setæ 5; 1 dorsal, 2 on each side..............pentathrix
Setæ 4; 3 frontal, 1 postero-terminal. Aquatic..............tetrathrix
Setæ 3; 2 frontal, 1 postero-terminal. Aquatic..............trithrix

65. PEDALION. II., 132.

One species .... mirum

66. DISCOPUS. Sup. 11.

One species. Parasitic on Synapta .... synaptæ

67. ASPLANCHNOPUS. Sup. 15.

a Foot scarcely visible; body bell-shaped; points of rami bifid .. syrinx
a Foot short; body humpless; points of rami simple .... myrmeleo
a Foot stout; body globose; rami long, teeth 4 .... eupode

68. TRIPHYLLUS. Sup. 19.

One species .... lacustris

69. TRIOPHTHALMUS. Sup. 32.

One species .... dorsualis

70. SEISON. Sup. 33.

Neck-segments 3; trunk not annulated .... grubei
Neck-segments more than 3; body-joints 4 .... annulatus

71. PARASEISON. Sup. 34.

No corona; small proboscis above mouth .... proboscideus
No corona; no proboscis; mouth with setæ .... asplanchnus
Corona present .... ciliatus

72. SACCOBDELLA. Sup. 34.

One species .... nebaliæ

73. DAPIDIA. Sup. 41.

One species .... stroma

74. DISPINTHERA. Sup. 47.

One species .... capsa

75. SCHIZOCERCA. Sup. 54.

One species .... diversicornis

76. GOMPHOGASTER. Sup. 57. (PLŒSOMA. Weber, 732.)

a Lorica elliptical, broad, short .... truncatum
a Lorica sub-conical, base frontal .... hudsoni
a Lorica rhomboidal, front truncate .... lenticulare
a Lorica oblong, flexible, trumpet-shaped laterally .... molle*

77. ANAPUS. Weber, 732.

Lateral furrow obscure; lorica transversely striate; ventral plate wider than dorsal .... ovalis
Lateral furrow broad, deep; lorica not striate; plates equally wide .... testudo

78. DINOPS.

One species .... longipes. Q., 1891, 255

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* Kellicott. Trans. Am. Micros. Soc., 1897, 47.

79. MICROCODIDES.

Corona as broad as the body; movements jerking..................robustus*
Corona small; body barrel-shaped; movements slow..............doliaris*

80. OCTOTROCHA.

One species, from China..speciosa. J., 1893, 146

81. GASTROPUS. Weber, 752.†

One species. Body rose color..stylifer

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*Jour. Quekett Micros. Club, 1895, 120.

†Weber in this genus includes Notops ruber, N. pygmæus, N. minor, N. hyptopus, Notommata hyptopus, Sacculus orbicularis.

ERRATA.

p. 89, 8th line from bottom; for 70, read 7.
90, 12th line from bottom; for 28, read 27.
97, 8th line from bottom and a few other places the specific names should not commence with capitals.
100, 1st and 2d lines from bottom, transpose reference marks.
102, 19th line, for "with three teeth," read "in a tube."

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On the Critical Employment of the Microscope For Ordinary Working Purposes.

A. A. MERLIN, F.R.M.S.

It is sufficiently evident to the observant visitor at microspical exhibitions and soirees that a large number of the specimens there shown, although most beautifully and carefully prepared and mounted by their exhibitors, are optically arranged with a total disregard of the rudimentary elements of critical microscopy, notwithstanding the fact that the instruments and accessories actually employed could be easily utilized so as to afford more satisfactory results. The following causes should perhaps be reckoned amongst those principally responsible for the existence of this state of things.

(1) The considerable training and practice required to enable the eye to fully grasp the points of difference between a critical and non-critical diffraction image, or to appreciate the delicately faint, but true, rendering of

all the visible features in the former case, as compared with the misleading and unreliable, although well-marked and obtrusive, diffraction outlines and effects invariably associated with the latter.

(2) The strong prejudice evinced by many workers in favor of an evenly-lighted 'moon' field in place of a sharply-focussed image of the light source. It is true that with a low-power substage condenser the focussed image of the lamp flame can be made to fill the entire field, but the rough-and-ready worker finds it much simpler to secure this result by lowering or raising his condenser.

(3) Carelessness and apathy regarding microspical manipulation; it being considered that the labor requisite for the acquirement of even an elementary knowledge of the subject would be a mere waste of time on the part of a naturalist or kindred worker.

(4) A conscientious objection to the critical large cone image on theoretical grounds; for, according to the Abbe dictum, "Strictly similar images cannot be expected, except with a central illumination with a narrow incident pencil, because this is the necessary condition for the possible admission of the whole of the diffracted light."

With regard to the first, nothing but practice and patient work will enable the microscopist to perceive in a delicate object all the minute faintly-outlined features just within the resolving power of the objective employed, and revealed by it under the action of a solid five-sixths or even six-sevenths axial cone from a well-corrected aplanatic substage condenser. It is true that under such conditions diffraction effects are conspicuously absent, the picture of a translucent object, such as a diatom, exhibiting almost as little contrast as would a perforated plate of clear glass held at arm's length between the eye and a bright background. But, although the resultant image is pale, the delineating and defining power of a good lens thus used, is such that in the case of a 4-

mm. apochromat of measured N.A. ·985 employed in conjunction with a copper acetate screen, the transverse striæ of a balsam mounted Amphipleura pellucida, running at about 94,000 to the inch, have been certainly seen and held for short intervals, 95,446 lines per inch being, according to Abbe, the theoretical separating limit for N.A. ·99 with oblique white light. When the illuminating cone was cut down so as to afford a working aperture of much under ·821, no true resolution could be distinguished. The effect of stopping out a small central portion of the large cone was also tried, the valve being then found to exhibit a smudgy corrugated appearance, but no cleanly-separated striation. Thus it would seem that the complete large solid cone is practically absolutely essential to the formation of a true image of an object possessing fine structure, or at least of the nearest possible approximation to such that the N.A. of the objective employed will allow. It must not be thought that this maximum resolution was attained or is attainable by merely screwing a fairly good objective on the nosepiece of any microscope stand provided with a condenser capable of yielding a large aplanatic cone. Other most important conditions are essential to success. Many years ago it was found necessary, in order to properly appreciate the faint details of images produced by means of a large illuminating cone, to work in a well-darkened room. Daylight must be excluded, and the microscope lamp should be provided with the well-known metal chimney, into the front of which a glass slip is inserted. An additional (small), well-shaded lamp is admissible when required for sketching or reference purposes, and will prove useful for reading the stage finder. In the second place, it will be found most advantageous in very difficult observations, after the preparation has been arranged on the stage and all optical adjustments carefully made, to completely rest the eye for an interval of from five to ten minutes before searching for faint detail. Frequent rests of this kind should also be taken in the course of all observational work. Thirdly, it should be remembered that the eye itself is an optical instrument which varies much in its capacity at different times. I find that from about an hour after lunch to 6 or 7 p. m. is decidedly the best period, but the evening hours can also be usefully employed. The morning is to me individually the most unfavorable part of the day for observational purposes, my eyes then becoming quickly and easily fatigued. It may well be, however, that the experience of others will differ in this respect, but each observer will probably find that his best work can only be accomplished during some certain hours of the day or evening.

But probably the easyest means by which the beginner will be enabled to most speedily convince himself of the advantages of critical microscopy for ordinary working purposes, lie in the proper employment of a good 1-in. or ⅔-in. objective of about N.A. ·30. Experiments with such a lens will be the more likely to prove instructive, as it has been over and over again asserted that, however necessary critical images may be when the higher magnifications are in question, the rough-and-ready method is quite satisfactory for low-power general work. To absolutely disprove the truth of this so frequently reiterated statement, you have only to place a common entomological object, such as the proboscis, wing, or leg of a fly, or other similar preparation, under, say, a cheap Leitz No. 3 objective (⅔-in.) of N.A. ·28, and sharply focus on the selected specimen the image of the edge of the lamp flame, using a low-power achromatic sub-stage condenser. Having done this, carefully examine the appearance of the smaller features of the object : (*a*) with the condenser diaphragm quite open, thus giving a full cone, *i. e.* when the eyepiece is removed the back of the objective appears evenly illuminated over its entire area ; (*b*) with the diaphragm a little closed so as to illuminate five-sixths of the central portion of the back lens of the objective, leaving a narrow dark outer annulus ; (*c*) with the diaphragm successively more and more closed up, so as to light respectively about $\frac{2}{3}$, $\frac{1}{2}$, $\frac{1}{4}$, and $\frac{1}{8}$th of the central part of the back lens. Then, on the same object, carefully observe the effect of lowering or raising the substage condenser beyond its focal point, an all too common expedient for obtaining an evenly-lighted field. In these experiments it will be advisable to use some simple form of light modifier, such as a piece of signal-green glass, and a rather high eyepiece may be employed with advantage in order to render differences in the quality of the various images more prominently visible. It should also be borne in mind, and experimentally verified, that when the back lens of the objective is nearly filled with light, it is extremely sensitive to any alteration of tube length or cover-glass thickness, a very slight increase or decrease of the former being sufficient to make or mar the sharpness of the resultant picture, while any oversight in making this adjustment will inevitably cause it to appear veiled and milky, even with a first-class apochromatic objective. Indeed, the better the lens employed the more sensitive it will be found in this respect. If the beginner will only examine a number of miscellaneous objects under the above specified conditions, there can be but little doubt that his conversion to critical microscopy, even for low-power every-day purposes, will be speedy.

Passing on to the second cause of the avoidance of critical methods of research by general observers, especially such as habitually employ low amplifications—*i. e.*, their strong predilection for an entirely illuminated "full-moon" field—it should be realized that if this condition be considered a *sine qua non*, there are several ways of easily obtaining it without putting the sub-stage condenser out of focus; that method will not be thought desirable by any one who has tried the experiments recommended above. Neither is the expedient of placing an auxiliary condenser in front of the lamp flame to be altogether commended, although a properly arranged and focussed aplanatic "bull's-eye" thus used is, in skilful hands, capable of affording good (but not strictly critical) results when compared to the images obtainable with an out-of-focus sub-stage condenser. The proper and easy way to obtain perfectly critical representations of objects viewed under a 1½-in. or 1-in. objective, with the whole field fully illuminated, is to employ a very low power achromatic condenser affording a sufficiently large aplanatic cone for the purpose. This maximum aperture need not exceed ·3 for the 1-in., and may be, of course, considerably less for the 1½-in.; but as it will be frequently found advantageous to utilize such an appliance with a ½-in., especially in photomicography, it should be capable of yielding a solid cone of N.A. ·5. Now, it is a remarkable fact that no cheap very-low power achromatic condenser of the kind above indicated is at present on the market, so that clearly no great demand for it exists, although there must be hundreds of earnest investigators to whom it would prove a boon could they once realize the advantages derivable from it. As a makeshift it will be found, however, that one of the ordinary triplet combination loups magnifying 6 times, when mounted in a suitable fitting and provided with an iris diaphragm, will answer well for 2-in. objectives, affording a large image of the light source, and practically filling the field when the broad part of the lamp is focussed. The Zeiss Abbe achromatic condenser with top lens removed gives even better results; and I would especially call attention to the modified semi-apochromatic form recently introduced by Baker, which, without the front lens, has a power of eight-tenths-in., and an *aplanatic* N.A. of ·5, thus rendering it available for use with a wide-angled ½-in. apochromat, while with the top lens *in situ*, it may be satisfactorily employed with the higher powers, being then a four-tenths-in. of aplanatic N.A. ·9; but in this latter respect the high power dry and oil-immersion condensers of all our leading opticians now leave little to be desired.

Regarding the third point—*i. e.*, the apparent carelessness and lack of interest in all optical matters evinced by many naturalists—it is difficult to believe that such men, most of whom will put themselves to infinite pains in the collection, careful preparation, and preservation of their specimens, could fail to be equally fastidious and painstaking with respect to the manner in which they exhibited to themselves and others the fruit of their hard work, toil none the less taxing because it happens to be entirely a labor of love, without thought of gain, were they once convinced that any practical advantage might be derivable in their own particular branches of research by a little more careful attention to optical principles. In some instances these workers may be deterred from any attempt to grapple with the subject by the mistaken idea that considerable study of an intricate nature in a, to them, uncongenial field is requisite, or that the cost of a proper instrumental outfit to secure optical results of a high order is quite beyond their means.

For the attainment of a strictly critical image the only essentials are :—(*a*) That the source of light (preferably the edge of a lamp flame) be sharply and centrally focussed on to the object by means of a sub-stage condenser of suitable aplanatic aperture, the microscope being either pointed directly to an illuminant, or, if the angle at which the instrument must be inclined to effect this should from any cause prove inconvenient, the plain mirror may be requisitioned to reflect the light into the condenser. Any light source which does not lend itself to being sharply focussed on the object, such as the incandescent electric lamp should be avoided. (*b*) That the aperture of the substage condenser diaphragm be, at least, large enough to illuminate three-quarters of the diameter of the back lens of the objective employed. (*c*) That the microscope tube length be such as to exactly compensate for variations in the thickness of the cover glass, this correction being readily effected by pulling out or sliding in the draw-tube, and by noting the varying clearness of the image. The best point is easily determinable when a large illuminating cone is used.

As to the instrument and indispensable accessories, it need only be said that our opticians now construct admirable small microscope stands, provided with good fine adjustments, at a cost of from $20 to $30 ; that the semi-apochromatic Leitz objectives are both cheap and most satisfactory in their performance when used in conjunction with very large illuminating cones, and that an aplanatic substage condenser is procurable at a trifling outlay. With such an outfit, costing in all not more than $45, results of an exceedingly high order, with low and medium magnifications, are readily attainable, the most massive and rigid stands of the Powell No. 1 type, and apochromatic objectives, being only absolutely necessary in the most difficult branches of research, and when the best attainable photomicrographs are in question.

Now we come to the fourth point, and have to consider the opponents of large-cone critical images on theoretical grounds, *i. e.*, those who think with Abbe that central illumination with a narrow incident pencil, the perfectly logical corollary drawn by him from his diffraction theory of microscopical vision, is the necessary condition for the attainment of an image strictly similar to the object, or at least the nearest possible approach thereto capable of being afforded by the objective which is being employed.

There is one infallible proof to which all theories, however profound or ingenious they may be, or however much we may admire the labors of their authors, have always, sooner or later, to submit, and by which they must inevitably stand or fall: and that is, *observed fact.* When a new and brilliant theory or any philosophical subject is first promulgated by some eminent scientist, it is the tendency of self-elected disciples, exponents, and admirers to permit themselves to be carried away by their enthusiasm, and go to lengths in defending and expounding the new tenets that their author would be perhaps the first to deprecate. Forgetting the lessons of the past that few indeed are the theories which have withstood the test of time unscathed, they from the outset regard matters not from a strictly impartial, but from a purely partisan standpoint, and while eagerly calling attention to and exaggerating the significance of such observations as may appear to them at the moment to favor their views, they on the other hand, heatedly call in question and throw doubt upon those which tend to the contrary, often without patient inquiry or experiment. It has been said that even a bad theory is better than none at all, and this is undoubtedly true in so far as it paves the way for that calm philosophical discussion from which we may hope to eventually attain some nearer approach to the truth, as distinct from controversy and personal recrimination, which can only serve to retard progress.

I am aware that many supporters of the diffraction theory, being not only theoretical but experienced and skilled practical microscopists, have now tacitly admitted the value of large-cone illumination, apparently realizing the wide gulf that such an admission has opened between their views and those of the author of the theory. In this connection it is instructive to notice that the deductions contained in the clear summary of the diffraction theory in the seventh edition of "Carpenter," published in 1891, which is peculiarly authoritative and weighty as having been submitted to Professor Abbe himself, and as having obtained his cordial endorsement, together with the expression of his greatest satisfaction of seeing his "views represented in the book so extensively and intensively," have not been in any way modified in the eighth edition published ten years later. This taken in conjunction with the significant fact that the best substage condenser constructed by the firm of Zeiss for use with the highest powers still only affords a maximum aplanatic cone of N.A. ·65, clearly indicates that, whatever admissions or changes of front his self-constituted supporters and defenders may have thought fit to make, Professor Abbe himself continues to unwaveringly maintain that strictly similar images are alone to be expected with the central narrow incident pencil, this being the necessary condition for the admission of the whole of the diffracted light.

What more wise and logical conclusion could be possibly reached on the hypothesis that microscopical vision is *sui generis*, and that "the images of minute objects are not delineated microscopically by means of the ordinary laws of refraction; they are not dioptrical results, but depend entirely on the laws of diffraction" ? Undoubtedly on any such assumptions as these, it is reasonable to maintain that the nearest possible approach to truth in the rendering of minute structure will be only attained with a narrow central illuminating pencil, for we can all easily satisfy ourselves by experiment that the strongest and most marked diffraction images and effects are thus obtainable. As we increase the diameter of the illuminating pencil we can experimentally observe that the picture rapidly becomes worse and worse from a diffractive point of view until when we reach a five-sixths or six-sevenths cone, no certain diffraction effects are discernible. In the case of a delicate object possessing fine structure we have an image greatly lacking contrast, and exhibiting no broad diffraction edges, in which we may glimpse points just within the theoretical grasp of the objective, the difficulty of holding these for any length of time strongly reminding a telescopist of his fleeting glimpses of planetary detail just visible under the most favorable atmospheric conditions. This is precisely the contrary of what we should expect to see according to the deductions from the diffraction theory summarized in "Carpenter," for these would make us feel confident that in the instance of the *A. pellucida* the central narrow incident pencil should produce the most truthful picture, and one more nearly approximating to the ultimate structure in exactness, than would be the case with a large pencil. But it is found by practice, that with N. A. ·985 and a large 5-6 or 6-7 cone, with light passed through a copper acetate screen, the striæ, running 94,000 to an in. are discernible and clearly separated, while they are absolutely invisibl with a much narrower pencil. The Abbe limit of resolution for N.A. ·99 being 95,446 lines to the inch with oblique white light (line E), and 103,458 with blue light (line F), therefore, if this observation is correct, we may feel confident that it is not the narrow, but the very large axial cone, which affords the maximum resolution, and the nearest possible approach to the complete rendering of the object that the aperture of the objective will permit.—*Quekett Club.*

Evolution as Seen in Amphiprora, One of the Bacillaria.

ARTHUR M. EDWARDS, M. D., F.L.S.

Amphiprora was a group called a genus of Diatomaeæ by C. G. Ehrenberg and published in his Abhandlungen, for 1843. I have already said in my paper in the American Journal of Science for 1891 that it is not an Amphiprora as now understood, but a Navicula of the Pinnularia type with pinnules and not striæ. The median canal is straight, not wavy, as Amphiprora has. Abhandlungen, published in 1843, is also dated 1844 and is known as Amer. The true genus is described by T. F. Kutzing in his Baccillarian, 1844, p. 107. He there includes A. alata which is Navicula alata C.G.E. (1840, Bor. p. 18). It was found at Cuxhaven, in brackish water, and Kutzing also found, at Trieste, in the Mediterranean, A. constricta, C.G.E. 1843 (Abhand. p. 122. Taf. II, IV, 28) found in the brackish water of Cuba. There is a Plagiotropis, A.G. which it will be necessary to consider as well as an Amphitropis, V.H., a sub-genus of Amphiprora. Amphiprora is defined in the latest book we have had on the Bacillaria : Synopsis des Diatomæ de Belgiques, 1880–'81, by Dr. Henri Van Heurck as follows: "Valves boat-shaped, with projecting keels, which are straight (Amphiprora) or sigmoid (Amphitropis). Central and terminal nodules little." He gives two Amphiprora, A. lepidoptera, W.G. var. pusilla, W. G. and A. maxima, W. G.—all from brackish water except that Gregory got them only on dead shells from the Firth of Clyde, Scotland. Three sub-genera Amphitropis alata, C.G.E., A. paludosa, W. S. A. duplex, A.S.D. and A. ornata, J. W. B. The first two are marine and brackish; the last, fresh-water.

Plagiotropis, E. P. and P. elegans, A. G.=Amphiprora, elegans W.S. and P. van heurckii, A.G., both are marine. The form of Plagiotropis is the same as the Amphiprora except that the median line is not sigmoid but direct.

A form is quite common in the fossil condition at Milburn, N. J., which I cannot see but is Plagiotropis vanheurckii. However, it does not agree with the form as figured to place it there. It is fresh-water instead of marine. It also occurs in the mud of the Second River, N. J., and is the same from the Rahway River, N. J. I have not seen it in a living state but it must be common in some of those streams, the Rahway, Elizabeth, Passaic or Hackensack. It is extremely delicate and the striæ are very fine. It is also very faint in color and can only be seen with difficulty. At all events it can be understood, when studied, to pass into Amphiprora alata, C.G.E. which is brackish and marine and is extremely common on the meadows of New Jersey and elsewhere.

In his Atlas to his Synopsis, Van Heurck figures Amphiprora (Amphitropis) pulchra, J.W.B., A (A.) conspicua, R.K.G., A. (A.) ornata. J.W.B., Plagiostropis van-heurckii A.G. and P. gibberula, A.G. Amphiprora pulchra, J.W.B. is a form that grows in salt-water on the meadows of Newark, N. J., and is a large form and is a sporangium of Amphiprora alata coming by A. conspicua which is also common in the Champlain deposit of the Atlantic Coast. We can thus see how evolution changes Amphiprora into Navicula on one side, and Amphora and Cymbella on the other. In fact, I believe it can be shown thus, how the whole Bacillaria are evoluted one from the other, but we cannot show it now for such a thing does not occur as evolution in one straight line. Thus, A was the form first made, or first created. Its descendants were B and B′ and B″. These descendants were from B, C, C′ and C″. From B′ there were C_2, C'_2 and C''_2 and so on. Now C is intercrossed with C_2 and had for descendents D, D′ and D″ and so on. So we can readily see but not reason how a form now came from the antecedent. But how soon it came, of course we cannot see or reason. We can perhaps see and reason how Amphiprora was formed even from Navicula, but Amphora and Cymbella were formed afterwards or before. But it is complicated to even think out. Remember that we are considering forms as they appear to our sight and not forms as they are by physiological research.

For Sale.—A Beck stand with three lenses, very little used. Price $10. Address: G.W. Wilcox, care this office.

The Chinch-bug Fungus.

H. GARMAN.

In the Middle States, the chinch-bug is attacked by several parasitic fungi, which appear to be very generally scattered ready to destroy the bug when the weather conditions are proper for their growth. They are in Kentucky, in Illinois, in Kansas, and in other states of the Ohio and Mississippi valleys. They are dependent on moisture, and when rains come they get their opportunity. But in New York where the chinch-bug is commonly very rare, these parasites, we may suppose, were not common in cultivated fields, and hence the bugs, once started, had, for a time, everything their own way.

Two of these plant-parasites are known to be particularly effective in destroying chinch-bugs. They are fungi, somewhat more highly organized than the microbes so often mentioned as causing epidemic diseases, but seem to act in much the same way, getting into the bodies of insects through the breathing pores, and by their growth in the interior, destroying the life of the attacked bugs, and then pushing through to the outside, where the fruit or spores are developed. The small growing threads are too small to be discerned with the unaided eye, and hence the only way to get a knowledge of the structure and manner of fruiting is by the use of the compound microscope. The presence of these fungi is to be known by the white or gray powdery coats formed on the backs, and often completely covering the dead bugs. The most common and active species has received the name "Chinch-bug Fungus." It is pure white as commonly seen on the bodies of insects, but when old, becomes of a light cream-yellow color. When it is grown in large masses, this change is especially marked.

The second fungus is not so common as the other, and has not, as far as I know, been grown artificially for distribution. It appears on the bugs in the field at times, and the Sporotrichum, has sometimes received credit for good work done by this species. It produces a gray coat on the bodies of dead bugs.

But chinch-bugs sometimes die in large numbers, and present none of the symptoms of attack by either of the above fungi. The fluids of these bugs examined under a microscope are often swarming with a micro-organism, which received, many years ago, the name "Bacillus insectorum." It is one of the microbes such as we find associated with certain infectious human diseases, and although it is easily grown artificially in beef broth and in nutrient gelatine, it has not, thus far, in experiment, proved of value in destroying the chinch-bug in the field.

These are the enemies most useful to us, it is thought from their destruction of chinch-bugs. The chinch-bug fungus (Sporotrichum) has been quite extensively grown artificially in several of the Middle States, and thousands of farmers have used it in their fields. In Kansas it has been more extensively used than elsewhere, and the testimony of farmers there has been at times strongly in favor of the effectiveness as a remedy for chinch-bug injury. The testimony of those who have been chiefly concerned in its culture and distribution is, however, somewhat less positive, owing, partly, to unquestionable failure of the fungus to catch under some circumstances, and partly to the fact that the fungus appears spontaneously in fields, making it impossible to say, under any ordinary field test, that it was actually introduced artificially. In Kentucky the fungus has been cultivated and distributed now for two summers to all farmers who applied for it. Not all who received packages have reported to me, but the majority of those reporting to date; who actually used the fungus, assert that it cleared their fields of the bugs. Some were in doubt, not being sure but that the disappearance of the bugs was caused directly by rainy weather. But in view of all chances of error, the outlook in the direction of destroying this and other pests with artificially grown parasites does not seem to me discouraging.—*Ky. Ag. Exp. Sta.*

A Simple Form of Monochromatic Illuminator for the Microscope.

ARTHUR M. EDWARDS, M.D., F.L.S.

For a long time, I have used a simple form of monochromatic illuminator, and it seems to answer perfectly. It can be employed for casting a colored light of one tint be it large or small. A whole room can thus be tinted any color it is desired to get, and, of course, it answers for use in the microscope. It may be described as giving a pure blue color, for that is the tint that it is most desirable to obtain. A vial is taken which has flat sides. Such an one is extremely common and is used by druggists everywhere. The size is not important but when used for the microscope, a small one (say of about two ounces capacity) will answer. When employed for illumination of larger objects, a larger one will be necessary, but a pint size is quite big enough.

This bottle is filled with water which has aniline blue dissolved in it. These are numerous but any of them will do for they transmit the right blue colors. When it is used, it is put between the source of light (sunlight or lamplight or gas flame), and the microscope so that the light through it can fall only on the object, be that concentrated by means of a mirror, or lens or falling simply on the slides. It is extraordinary how pure the light seems when thus viewed. The most difficult object, as Hyalodiscus subtilis or even Suriella gemma seems to start out when thus viewed, and the markings seem to be easy to resolve. In fact, we find that any other color than blue seems to be glaring, and we always turn to it again when we view any objects. I wish it would be tried. Remember the contrivance is easy to make, and is extremely cheap.

Notes on the Method of Feeding of Phyllopods and Cladocera.

MARCUS HARTOG, M. A., D. Sc.

In the course of some hatching experiments with Apus and Branchipus I incidentally noticed that they fed lying on their backs, the swing of the appendages producing a backward current of the water down either side, while the inmost lobes ("gnathobasites" of Lankester) sent an upstream along the median line to the mouth. The food consisted of the floating materials in the water, and was swallowed by the combined movements of the mandibles and the peristaltic action of the gullet. The two mandibles work so that the one has greater play than the other, carrying the suspended matters past it right into the gullet.

It is interesting to compare this with the more complex arrangements of Cladocera. To study these in Daphnia, etc., we require a good magnification by a low-angle lens, such as the B (½ in.) and C(¼ in.) of Zeiss; and the animal must lie in a cell, preferably uucovered, deep enough to allow it free play. Here the thorasic appendages cause a flow of water into the shell through the angles on either side between the valves and the beaked head, and immediately past the anterior antennae, which are thus in the very best position, as sense organs, for perceiving any change in the properties of the indraught. The stream flows backwards between the valves in the space traversed by the limbs proper and their pectinate plates. Into the gill-cavities, between the valves and the outer side of the limbs, no formed particles can be seen to pass, as the pectinate plates on the limbs, which make them so efficient in producing the current, are equally efficient as sieves or filters. The solid particles in suspension as they pass back drift into the angle where the hinder end of the body bends abruptly down. Here they are turned forward into a reverse eddy, forwards, under and along the median line of the body, till they reach the oral region behind the labrum, where the play of the mandibles, like that of Apus, sends them into the gullet to be swallowed. If the solids in the water be in excess, the accumulation against the labrum is too large to be dealt with in this way; and the hinder end of the body, armed as it is with two strong spines, is, as it were, scraped along the median groove, and turned sharply downwards and backwards at the end of the stroke, so as to scoop away the clogging mass and expel it from the shell.

I may note also that by adding carmine to the water we can see that the food passes freely from the gut proper into the pyloric caeca, which are, therefore, not merely secreting organs.

They may often be seen feeding in this way when resting by the back of the head against a weed or the wall of the vessel. A large sensory nerve ends here, and possibly the end organ may secrete matter viscid enough to fix the animal, so long as it does not execute vigorous swimming movements. This "dorsal organ" (or rather "nuchal organ") is especially well developed in Sida.

While the general rhythm of the bulk of the limbs of crustacea is backwards, their bases and their epipodial appendages tend to work in the reverse direction. This is especially visible in the last gill of Daphnia, and is notably the case with the gills, etc., of the Decapoda, the highest group.

The Nauplius larva of Cyclops has a so-called "masticatory hook" at the base of its second pair of appendages, which works into the pharynx just in the same way as do the mandibles of Apus or Daphnia.—*Quekett Club.*

Notes on Microscopy.

M. I. CROSS.

POND-LIFE COLLECTING IN JULY.—Collecting in July is usually not so profitable as one would expect, because as a rule most of the shallow ponds are dried up by this time, or have been reduced to a muddy swamp, and in the others the Crustaceans, Cladocera and Cyclops, have multiplied to such an extent as to leave little room for the more interesting forms of pond-life.

Pedalion mirum should be looked for in large and small lakes, as it will probably have greatly increased in numbers. The somewhat rare and very large Asplanchna amphora and ebbesborni, as well as Asplanchnopus myrmelo, are summer forms which occur at this season. Other Rotifers that appear in warm weather are : Dinops longipes, Tribyllus lacustris, Notops clavulatus, Scaridium eudactilotum, and longicaudum, then the free-swimming Lacinularia natans and Conochilus volvox, also the fixed Lacinularia socialis and Megalotrocha, which are found attached to submerged water plants. All these are very beautiful objects under the microscope, but by no means common. Volvox globator will certainly be found now, in abundance, in secluded ponds, and inside of the green spheres the little parasitic Rotifer, Proales parasitica, should be looked for.

HINTS ON SECTION CUTTING.—Success in microtome section cutting, no matter what microtome be used, can only be properly attained by dexterity in free-hand section cutting. A few directions which will indicate the manner in which this desirable facility may be secured may, therefore, be of value. It calls for patience, care, and some practice. It is well to select botanical subjects of small diameter and not too hard in substance to experiment upon. Bear in mind that the smaller the diameter of the material the easie will it be to cut good sections.

The material should be placed in a bottle of 90 per cent alcohol for three or four days before cutting, and when the operation is in progress, a cup should be provided to receive the razor also containing 90 per cent alcohol, a saucer with the same spirit in it to dip the material in, and another to receive the sections. A sable-hair brush will also be required of the size known as crow-quill ; camel-hair brushes being useless.

The material should be held vertically between the thumb and index finger of the left hand, allowing it to rest in the first bend of the finger and keeping the thumb ¼ inch below the level of the finger. The upper end of the material to be cut should be about level with the finger, the razor being held lightly but firmly, chiefly with the thumb and index finger of the right hand. Well wet the material and razor with the alcohol, place the blade of the razor flat upon the index finger of the left hand and cutting from heel to point, or by pushing the razor away from you and cutting from point to heel. As each section is cut, it should be lightly brushed from the razor into the saucer of alcohol, and when, say, one hundred sections have been made, the thinnest and best half dozen may be selected and the process repeated for practice. A further selection of the best may then be made. *Knowledge, London, Eng.*

MISCELLANEOUS.

JAS. H. STEBBINS, Jr., Microscopist, 80 Madison av., New York city. Photo-micrographs, lantern slides, sections, slides, etc. Pathological examinations, sputum, urine, etc.

The Popular Science Monthly for May. J. A. Fleming explains the important advantages which have entirely altered our ideas of the structure of matter, of electricity and of the ether.

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